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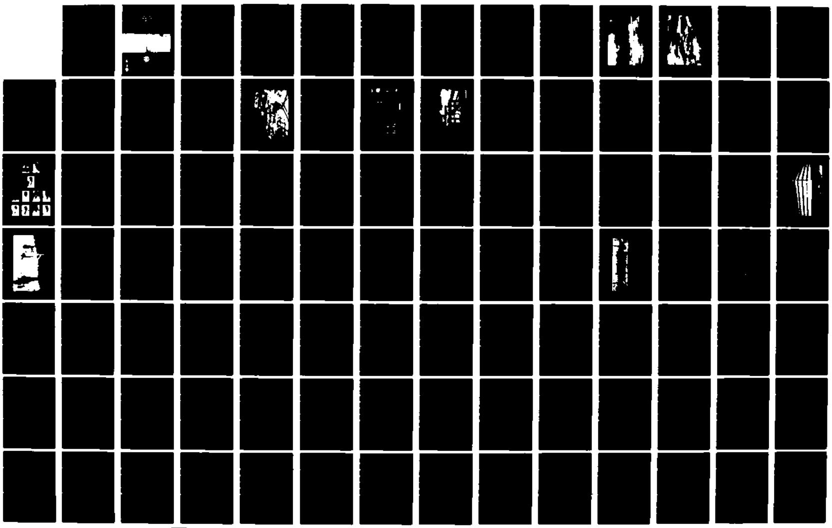

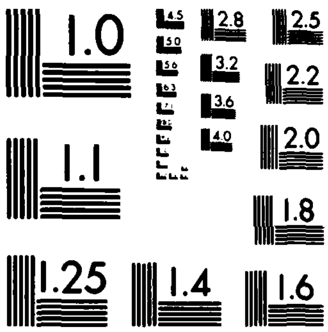

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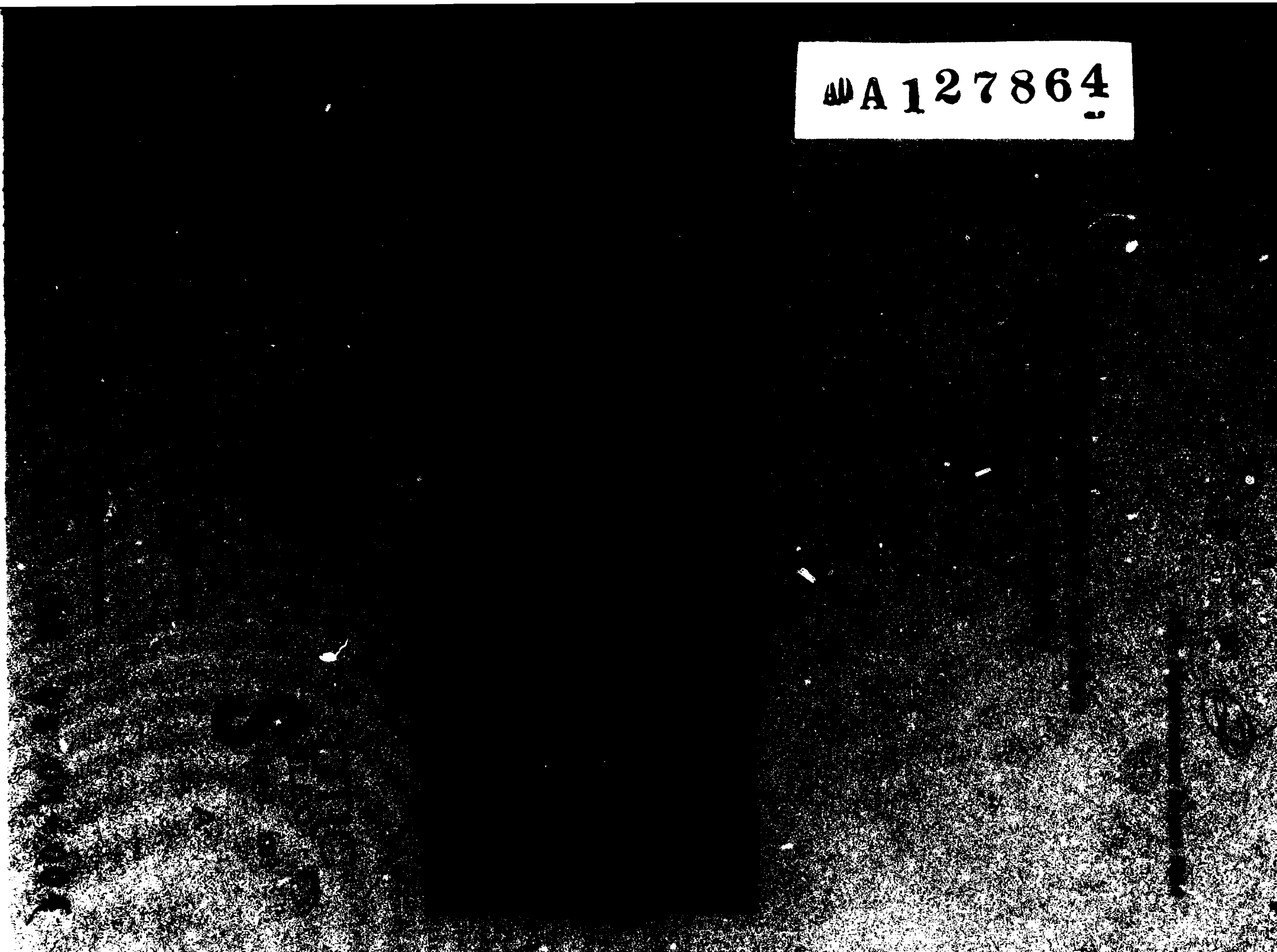

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This history is written for the employees of the Chemistry Division. It is designed to provide a narrative history of the Chemistry Division, its employees and their research. If there is a theme, it is that implied in the text — the development here of the field of chemistry by people intelligent enough to want good chemistry and willing to work for it.

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CONTENTS

"Fortunately science, like that nature to which it belongs, is neither limited by time nor space. It belongs to the world, and is of no country and of no age. The more we feel how much remains unknown; and in philosophy, the sentiment of the Macedonian hero can never apply, - there are always new worlds to conquer." (Sir Humphry Davy, 30th November 1825)

PREFACE

This history is written for the employees of the Chemistry Division. It is designed to provide a narrative history of the Chemistry Division, its employees and their research. If there is a theme, it is that implied in the text - the development here of the field of chemistry by people intelligent enough to want good chemistry and willing to work for it.

Embodied here is original Chemistry Division scientific research and the advancement of new interpretations for the time periods cited. Only a limited presentation of our Division research results is included; rather the text follows, in a general way, the organization and subject matter of various pieces of written material, oral notes, and other sources not mentioned, from which the author gained her information. Of necessity, I have given a somewhat incomplete picture of the Division's operations and accomplishments. The history also does not convey the immense contribution of our staff in the form of advice, consultations, and emergency services provided to many U. S. Navy and other Defense as well as non-Defense organizations. The included selections are set in their historical context in such a way as to make it possible, for a reader with a modest knowledge of the Division, to read them profitably and with pleasure.

To you who are new in the Chemistry Division, you have joined the staff of one of the principal chemical research and development institutions of the U. S. Government. Whatever your assignment, you will have an excellent opportunity to contribute to significant work which will enable the Chemistry Division to continue its outstanding record of achievement in advancing chemical science and technology for the Navy and other Defense organizations.

ACKNOWLEDGEMENTS

In retrospect where positive errors have been recognized, I have taken the liberty to correct and/or insert changes. I am not a professional historian and all errors of fact and judgement are exclusively my own.

As follows, I should like to acknowledge with sincere gratitude those who assisted me in the preparation of these historical selections.

This history would not have been possible without the original idea to write this tome as well as the encouragement, assistance and criticisms offered to the author by Dr. F. E. Saalfeld, Superintendent of the Chemistry Division, from 1976 through October, 1982, and the unfailing patience and support October, 1982, through December, 1982, of Dr. D. L. Venezky, Associate Superintendent.

I am indebted to all the supervisors and coworkers with whom I shared work from 1950 through 1982; they were not only outstanding scientists, technicians, and administrative personnel, but terrific human beings. However, I owe a SPECIAL debt of gratitude to my first and last supervisors. Dr. William A. Zisman, as Branch Head, hired me as his secretary and gave me the opportunity, when he became the Division Superintendent, to be his Administrative Assistant. His unfailing confidence in my administrative capability was so sincere that eventually he convinced me to believe in myself, and therefore I made every effort not to disappoint him in performance of my duties. Dr. Fred E. Saalfeld had the same psychological impact on me - because of his confidence in me, his enthusiasm, motivation and love of NRL and the Navy - my admiration for these qualities in a leader made me try harder!

During my tenure in the Chemistry Division there is one person whom I could not have done without - Mrs. Elaine G. Shafrin! Whenever I needed assistance in scientific nomenclature, equations, mathematics, etc., she was ever present. After having completed the rough draft of this history, it was only natural for me to request her expert advice. As usual, she gave me her comments, but the greatest gift was her "congratulations" - which I shall never forget because it was from my trusted and experienced counselor.

A special thanks is given to Mrs. Kathryne Kozak, daughter of Dr. F. R. Bichowsky (our first Superintendent), who so kindly came to NRL, discussed her father with us and loaned me her father's papers, records, pictures. and other material to include in this writing.

I must mention my gratitude for the unflagging assistance of those coworkers who gave me encouragement and assisted me in delving for information to complete this history: Mrs. Joan

Benedict, Mr. Robert C. Clark, Mrs. Carol DeLozier, Dr. James R. Griffith, Dr. Luther B. Lockhart, Jr., Mr. James Romans, Mr. Steve Tate and Ms. Stacie Thume.

Thanks also to Dr. Robert B. Fox who came to my rescue by requesting his ACS contacts to scan their files of deceased members so I could complete the necessary biography information.

All of these folks endured my various requests and helped an Administrative Officer become a historian.

A HISTORY OF THE CHEMISTRY DIVISION
NAVAL RESEARCH LABORATORY
WASHINGTON, D. C.
1927 — 1982

I. Origins, 1915 - 1927 (1) (2)

Although the Naval Research Laboratory (NRL) was officially commissioned in 1923, its roots extend back still further to 1915 and the foresighted American inventor, Thomas A. Edison.

The then-Secretary of the Navy. Josephus Daniels, seized upon a proposal made by Mr. Edison and asked him to serve as chairman of a board to plan the founding of a great research laboratory, jointly under naval and civilian control, to house the facilities and machinery necessary to utilize the natural inventive genius of Americans in meeting new conditions of warfare. Edison agreed and the resulting Naval Consulting Board of the United States* (first known as the Naval Advisory Board) recommended to a Congressional committee that a naval laboratory be constructed to obtain the best results from the work they proposed along the lines of research and invention.

The enabling act, with an appropriation of $1.5 million for setting up the Laboratory, was passed by the 64th Congress and signed by President Wilson in 1916. The intervention of World War I and problems associated with site selection delayed the actual groundbreaking for the first Laboratory buildings until December 1920 (Figure 1 - Original NRL Farm Site in approximately 1920). The official commissioning of the facility, which at the outset consisted of a mere five buildings and twenty employees, took place on July 2, 1923 (Figure 2 - NRL under construction, 1922).

Among the first group of employees at the Laboratory were a number of remarkable individuals, including Dr. A. Hoyt Taylor, the Navy's Chief Physicist, and his assistants, Leo C. Young and Dr. Louis A. Gebhard, all destined for greatness in the fields of radio and radar, and Dr. Harvey C. Hayes, a pioneer in underwater acoustics.

During World War I, military operations beneath the sea had become an awesome reality. Furthermore. by 1917 and 1918 the Fleet had come to depend heavily on wireless communications. As a result, Radio and Sound were the first two Divisions founded at NRL.

Although the research areas of radio and sound received the major emphasis in those early years, researchers at the Laboratory were soon carrying out scientific projects in many other fields that would later prove fruitful to the Navy and the defense of the Nation as a whole.

* A member of this board was the then-Assistant Secretary of the Navy, Franklin D. Roosevelt.

Manuscript approved December 15, 1982.


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Fig. 1 — Original NRL Farm Site (approximate date of 1920)

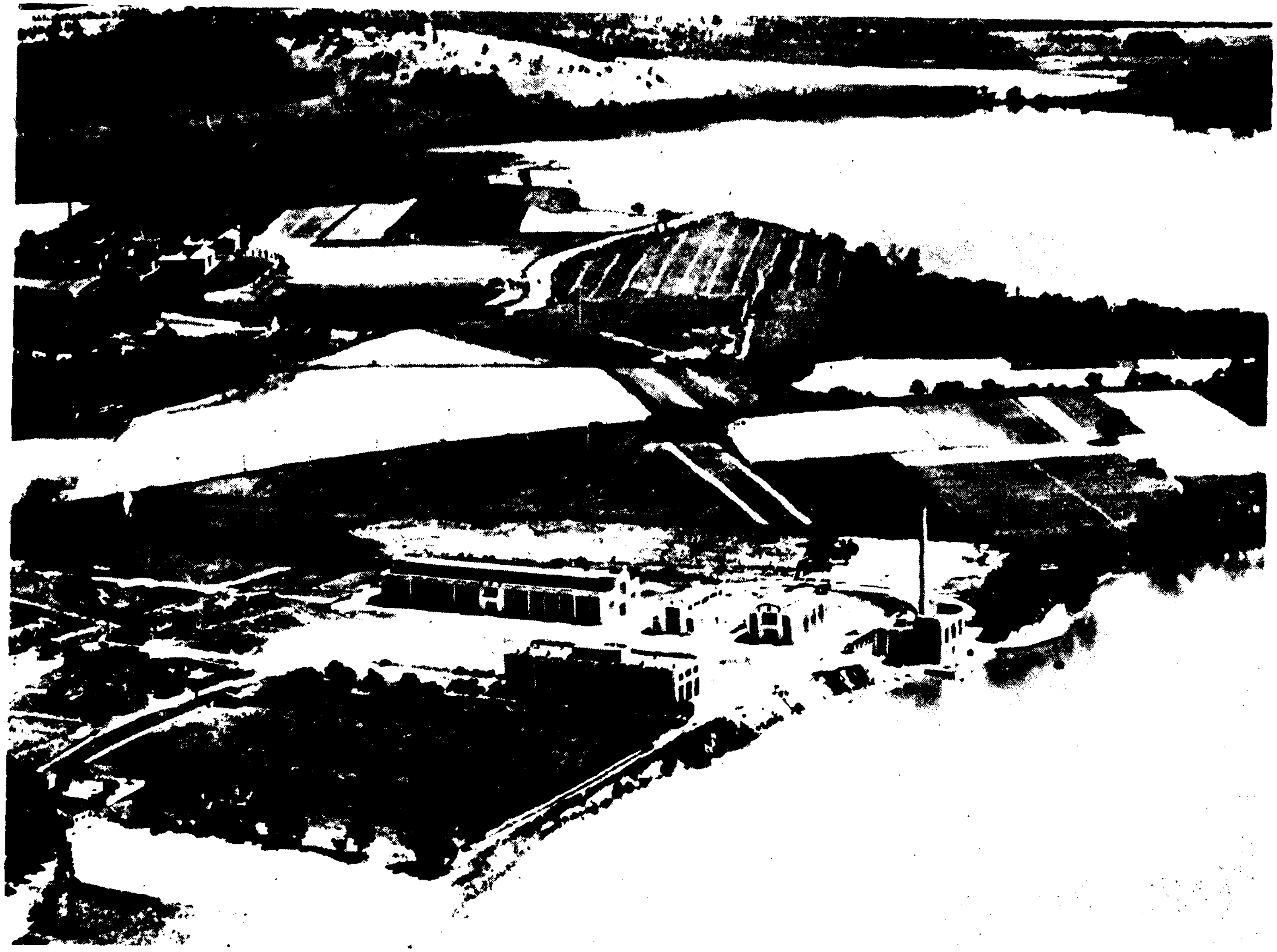

Fig. 2 — NRL under construction, 1922.

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About a year after the Laboratory opened its doors, the Heat and Light Division was established to conduct thermal and optical research; by the mid thirties, three other divisions had been added: CHEMISTRY in 1927, Metallurgy and Mechanics.

II. The First and Second Decade of the Chemistry Division 1927 - 1949

BICHOWSKY ERA (3)

The Naval Research Laboratory Chemistry Division was created about September 1927. Dr. Francis Russell Bichowsky, who had been an associate professor at Johns Hopkins University (1924 - 1927), was its first Superintendent (1927 - 1933) (see Appendix A, Dr. Bichowsky's Resume) (Appendix G is a copy of Dr. Bichowsky's personal concept of the early history of the Chemistry Division and used by Dr. Taylor in Reference 3).

The Division took over work being done by Dr. H. H. Moore's Ballistics Section which had been transferred to NRL from the National Bureau of Standards in 1923, and absorbed a small analytic laboratory which had been in operation at NRL for two years under Dr. Melton Hartman, a former Warrant Officer chemist in the Navy. Three other men, Dr. Walter Rosett, Mr. Frank Yirka, and Mr. L. Singer completed the early complement. Two years later, Dr. Parry Borgstrom also of Johns Hopkins joined the Division. Another early chemist was Dr. Edward Lunn, who joined the Laboratory's scientific staff the latter part of 1929.

When the Chemistry Division was established, Dr. Bichowsky made an informal stipulation that a third of the time and money available to the Division should be devoted to publishable research of the so-called "pure" type. It was obvious, however, that if the Division was to develop into a lusty and self-sufficient research organization, its initial projects would have to be immediately adaptable to Navy use. At the outset CAPT Oberlin (Commander E. G. Oberlin was the FIRST Assistant Director in Residence at NRL; later he was promoted to Captain and became Director of NRL in 1931, serving until 1932) was most anxious to attract support of the Bureau of Ordnance. Most of the early work of the Division was, therefore, devoted to three programs: the development of new fuels or power sources for torpedoes; the prevention of battery-gas explosions in submarines; and the study of oxygen sources which might be utilized to purify the air in submerged submarines.

The torpedo-propulsion problem was a sort of "trial balloon" handed to the Laboratory by the Bureau of Ordnance. It consisted actually of two projects, an exothermic torpedo and an oxygen torpedo. The first project was inherited from some work done by Mr. Kelsey of Westinghouse Corporation for the Bureau of Ordnance near the end of World War I. Kelsey's idea was to replace compressed air as a source of power by steam generated in the course of a chemical reaction. The idea of the second project, the oxygen torpedo, was to use, instead of compressed air, air enriched in oxygen or replaced by pure oxygen if that

was found feasible. Both problems promised to be very difficult but well worth the effort of the Laboratory. Not only was it highly desirable to obtain the enthusiastic support of the Bureau of Ordnance, but Mr. Wilbur, then Secretary of the Navy, was personally interested in the torpedo. Quite correctly he thought it was one weapon which had not been developed to its fullest extent.

The study of the exothermic torpedo was not long underway when it became immediately apparent that the particular combinations of chemicals used by Kelsey apparently introduced unsolvable difficulties of control. Accordingly, it was suggested that the original chemicals be replaced with some others not previously tried. The new chemicals have the advantages of making it unnecessary to mix two highly dangerous materials before combustion and allowing proper control of the combustion without danger of spontaneous explosion. It also had the practical advantages that: (1) It would make it possible to isolate two separate problems and make possible the design of a "pot" (combustion chamber) capable of resisting very high temperatures, and (2) the problem of storing and supplying the two components would be greatly simplified.

Since the problem of the "pot" was more difficult and since the solution of the "pot" problem would also carry with it the solution of the oxygen torpedo, it was decided to concentrate activities on that part of the problem under Dr. Moore. Dr. Moore was responsible for working out the details of the various ingenious "pot" designs; the rapid progress made towards solving the problem of the oxygen torpedo was largely due to him.

In the meantime, experiments had been underway with the aim of replacing the oxygen in the oxygen torpedo with another substance. Sometime around 1929 the internal workings of the rockets had been designed in which thrust was obtained by combustion of new materials. The first experiment was a success in that acceleration of 2G was obtained. But as might have been anticipated, the reaction was accompanied by occasional minor explosions. However, it was conclusively shown that a great deal of power could be obtained from the combination if only it could be controlled. Furthermore, the use of the new fuels seemed to offer the possibilities of developing explosives of unheard-of power. After uncontrollable explosions temporarily halted work on these new torpedo fuels, Drs. Lunn and Bichowsky prepared compounds without explosions and found conditions under which the material could be handled safely.

About 1930 the Laboratory inherited the problem of battery explosions in submarines. Dr. Lunn was asked to help out on this problem. After crawling around a particularly disreputable "pig boat" he noted that the inner surfaces of the ventilating ducts were covered with sulfuric acid spray and showed evidence of many minor fires in the submarine ventilating system. These

were caused by small sparks produced when the conducting film of sulfuric acid on the inside of the ducts was broken by the motion of the ship. This discovery led to a long study of the ventilating system of submarine batteries. So fascinating did this problem become that Dr. Lunn never went back to "pure" research.

On one occasion it was noted that the ventilation of the individual battery cells was very irregular. The problem was to measure the ventilation in each of the 120 cells yet the flow was too slow to be measured with the instruments of standard design. Dr. Lunn got the idea of measuring the flow with some chemical mist or smoke in tubes. The Commanding Officer refused to allow Dr. Lunn to do the experiment with ammonium chloride smoke which might damage the battery. Lunn then suggested the use of tobacco smoke as an indicator of air flow. A preliminary investigation for which NRL chemists had the cordial cooperation of several in the Laboratory, proved that Blackstone cigars made the maximum of smoke. So the technique was to get a good smoker and to have him on signal puff a small amount of smoke into the entrance of a glass tube. Dr. Lunn with a stopwatch would then measure the time taken for smoke to travel down the tube and thus the rate of battery ventilation. He called for volunteers and the crew responded in a body. Picking out a husky Chief's Electrician Mate he set to work; the Mate lasted about 20 batteries - others now were not so enthusiastic about volunteering. Eventually, Lunn had to invent a mechanical cigar-smoking machine to furnish the necessary puffs.

This work with the battery explosions led to other studies connected with submarines. One under the direction of Dr. Borgstrom concerned the replacement of soda lime as the purifying agent for air. Dr. Borgstrom hit on the use of lithium hydroxide and his experiments in this connection led to improvements of submarine safety. A second attack on the submarine problem was the study undertaken to control the production of spray in the storage battery. Dr. Lunn was responsible for this work. In the meantime it had been suggested by several people that studies be undertaken to seal the storage battery so that no ventilation would be necessary. Dr. Crockford of the University of North Carolina was employed on a contract basis to work on this problem in the Chemistry Division during the summer.

It will be seen that Dr. Bichowsky's dream that a third of the effort of the Division be devoted to basic research, had been somewhat wistful. The Superintendent and Dr. Lunn had started some research on the mechanisms of reactions in vacuum tubes, and a few other small projects were undertaken from time to time. In the main, however, the Chemistry Division had to wait several years before it could undertake any long range fundamental problems.

The Chemistry Division had come to the aid of the Radio Division in helping to guide the development of new dielectrics which would have low losses at what was then considered high frequency, which meant anything over 4,000 kilocycles. One of our chemists, probably Dr. Bichowsky, while making a visit to the Naugatuck Chemical Company, a subsidiary of the United States Rubber Company, was shown a new plastic material which could be given various colors. It had an attractive appearance and was a by-product obtained in the manufacturing of certain alcohols. It was said to be too expensive to be used for toothbrushes or toilet articles and the chemical company doubted that they could make any practical use of it. Dr. Bichowsky said, "Let me have a few samples of this substance and we will find out something about its dielectric properties. Our Radio Division is always looking for new and better dielectrics." This started an interesting development involving the cooperation of the Chemistry and the Radio Divisions at NRL with the chemists of the Naugatuck Company. This resulted in a production of "Victron" which for some time was extremely useful in pushing studies of higher and higher frequencies, although from its melting point and mechanical strength, it was not fully satisfactory.

In the early 1930's, there were lean years. Chemistry continued active work in connection with problems affecting submarines, such as battery ventilation systems, fire extinguishers, flow meters, etc. Fuel-oil investigations were started in 1931 as were studies on paints, particularly anti-fouling paints. The Division also developed a special visibility meter, an illuminated gun sight and carried out studies on the problems of recovering water from the exhaust of engines for lighter-than-air craft engines (in order to compensate for the weight loss by the consumption of fuel). It also did notable work in connection with the problems of submarine visual recognition signals and by 1934 was doing important work on the inhibition of corrosion in containers used for storing gasoline aboard ships.

BORGSTROM ERA

Dr. F. R. Bichowsky resigned in 1933 and Dr. P. Borgstrom became the Division's second Superintendent (see Appendix B - Dr. Borgstrom's resume) in 1934.

The physical expansion of the laboratory which had been almost at a standstill during the "lean years" was moderate during the pre-war period. The first chemical laboratory, later designated as Building 32 was put up jointly by WPA and NRL. It was completed in 1938 and an addition was finished in 1941 (Figure 3 - NRL as it appeared in 1938).

The Chemistry Division, which in 1935 had but ten employees and only two sections, began its expansion about 1937. On the eve of the second world conflict there were approximately 25 chemists and assistants that worked in five sections. The four year period before the war also saw the Chemistry Division commence research directed to solving some of its most important wartime problems.

Other than the Chemistry Division employees already cited in this text, the following personnel who were to become Division staff personnel were hired, first under contract then as NRL employees, in the following chronological order:

1936 - Mr. R. R. Miller
1937 - Dr. J. C. White
1938 - Dr. T. P. May
Mr. R. L. Tuve
Dr. A. L. Alexander
1939 - Dr. W. A. Zisman
Dr. D. Fore, Jr.
Dr. P. King
1940 - Dr. W. C. Lanning
Dr. E. A. Ramskill
Dr. M. A. Elliott
1941 - Dr. J. E. Johnson
Mr. S. Gulbrandsen

One of the most important new programs and one which was to require the largest operating force during the war was the development of offensive and protective chemical warfare devices. Chemical warfare had always been considered more or less a monopoly of the Army, and the Navy had never done much about it. In 1940 the Laboratory acquired both information and materials relating to chemical warfare research from the Army's Edgewood Arsenal. Under Dr. W. C. Lanning, the Chemical Warfare Section was established in the Chemistry Division.

A second of the new programs was a series of investigations covered by the general term "corrosion studies." The particular emphasis was on the development of anti-fouling paints for

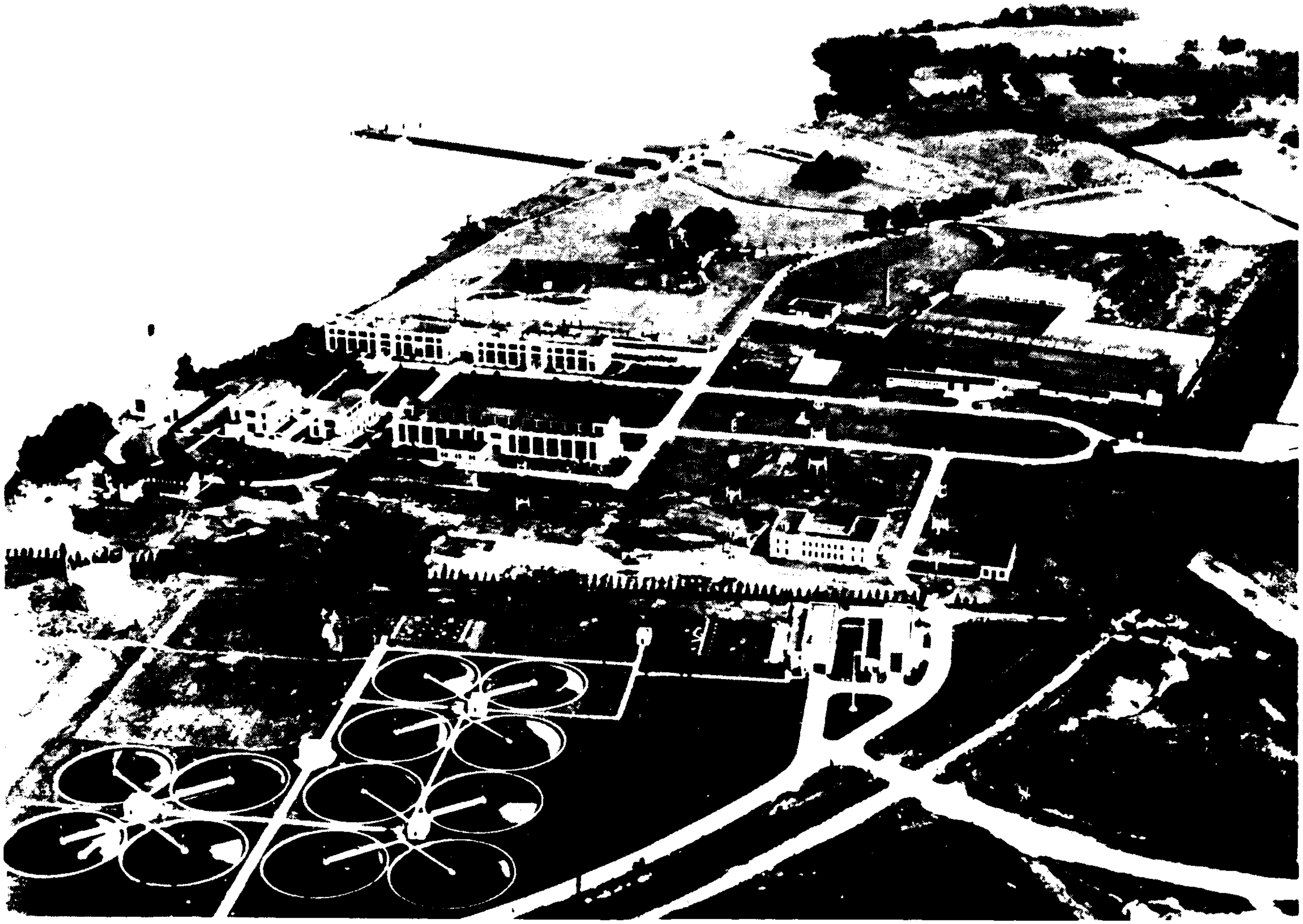

Fig. 3 — NRL as it appeared in 1938.

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coating ships' hulls, aircraft pontoons and a search for a suitable non-corrosive additive for fuel and lubricating oil. This work was started in 1938 under Dr. T. P. May.

Meanwhile, the older programs, the work on oxygen yielding compounds and the investigation on storage batteries continued at a greatly accelerated pace. The former remained in a physical and organic section and the latter was given its own section (Electrochemistry) under Dr. J. C. White.

In the five years from 1940 to VJ Day, the Chemistry Division underwent the greatest expansion of any of the pre-war "basic science" divisions. Chemistry Division employees, for the most part, now occupied Buildings 26, 35 and 54 (Figures 4 and 5 depict these building; however, the only photographs obtainable were of these buildings in the 1960's). The physical and personnel expansion of the Division was accompanied by a remarkable diversification in research projects. The number of sections increased from five to eleven and there was often a wide range of studies within each section. Indeed, research problems came in such a quantity that the Division was forced to subcontract many of its investigations to college and university laboratories all over the nation.

The biggest "war baby" was chemical warfare research which monopolized the efforts of the Division's largest Section. Under the direction of Dr. Lanning, this Section adapted for Naval use the various devices and chemical weapons created by the Army Chemical Warfare Service and went on to develop many of their own for the particular needs of the Navy. In addition, NRL chemists built and operated a pair of impregnating plants for the treatment of protective clothing and produced on the station most of the chemicals which were used in the gas mask canisters issued to Navy personnel.

Dr. May's Corrosion Section which had originally been established to develop rust inhibiting compounds covered a far wider variety of subjects than its name would indicate. In addition to working on various rust-inhibiting paint pigments, the Section also undertook investigations of materials for use under adverse weather conditions. These included a de-icing fluid, a rain-repellant coating for aircraft windshields and a defogging agent for optical surfaces - all of which became standard for both the Army and the Navy. Somewhat similar work was carried on in the Protective Coating Section which studied finishes for Navy vessels and equipment. Particular attention was given to anti-fouling paints, camouflage coverings, infrared reflecting paints, and coatings for all types of equipment to protect them from deterioration in tropical climates. This work was led by Dr. A. L. Alexander.

In approximately 1948-49, an activity known as the Tropical Exposure Site, Fort Sherman, Panama Canal Zone (previously

Fig. 4 — Chemistry Division Buildings 26 (center rear), 35 (to the left) and 54 (to the right), mid-1960's.

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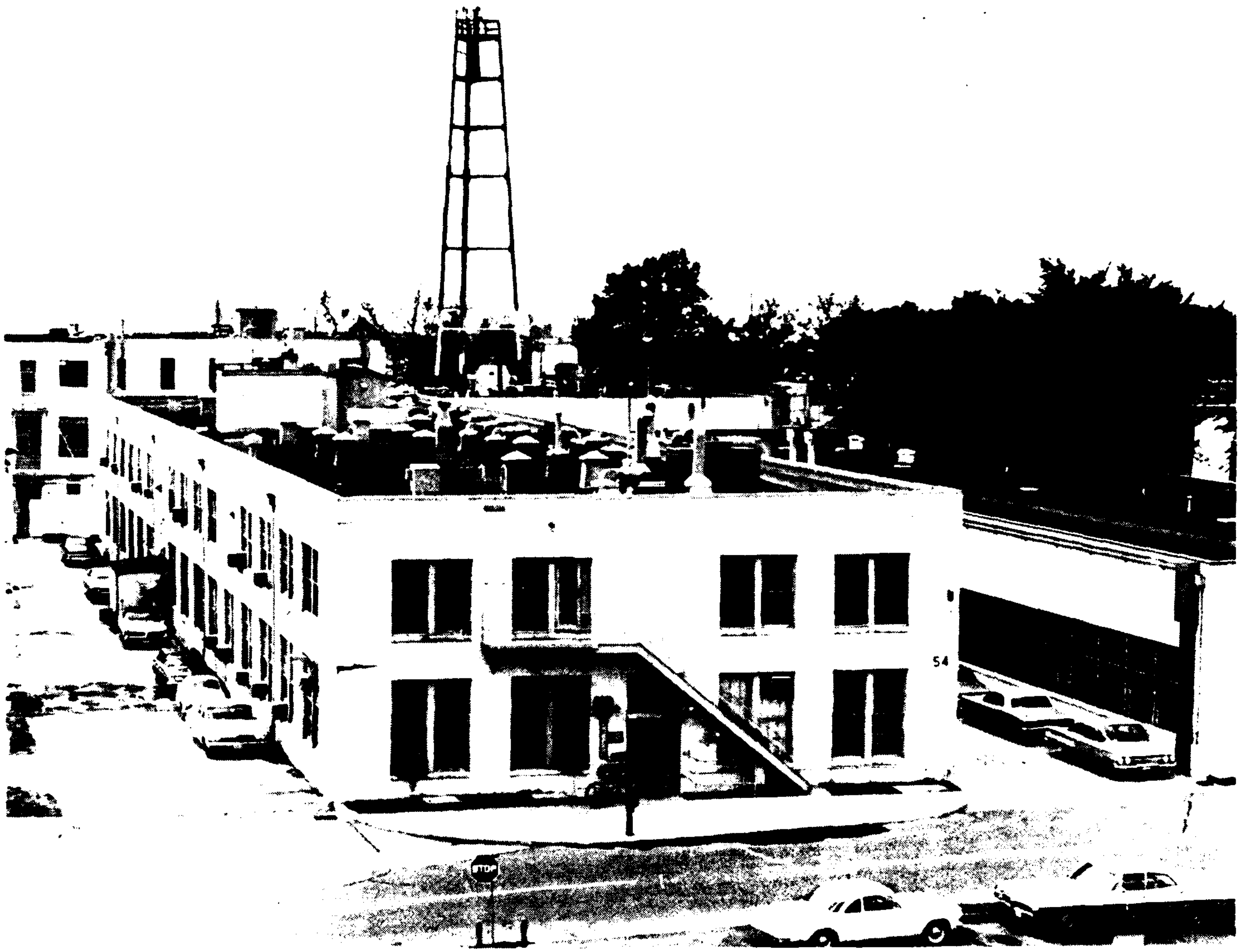

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Fig. 5 — Chemistry Building 54 in the mid-1960's (this was considered the main Chemistry Division Building — probably because the Superintendent maintained his office here).

supported by the University of Pennsylvania under Office of Naval Research contract), was taken over by the Chemistry Division's Protective Coatings Branch to test the effect of tropical climate on various materials (i.e., paints, fire hoses, electronic instruments, etc.). A centralized laboratory for material exposure research projects, the Canal Zone Corrosion Laboratory. Miraflores, Canal Zone (supported jointly by the Panama Canal Company, the Army Engineering Research and Development Laboratories, and NRL, which was assigned technical management control) was established by the Protective Chemistry Branch in approximately 1953. Acquisition of this property coordinated the Canal Zone Corrosion Laboratory's research and development work with the existing NRL Tropical Exposure Site.

Another wartime unit was a section devoted to the study of lubricants. Of particular interest was the development of special purpose oils and greases which had all the characteristics of low flammability and high stability under both high temperature and low temperature conditions. These characteristics made the new lubricant particularly useful for aircraft instruments and for military uses in all types of climates. A similar section worked on new fuels and methods of fuel storage. Dr. W. A. Zisman and Dr. D. Fore. Jr., were the respective Section Heads for these two programs.

Meantime the chemists in other sections were studying insulating and dielectric materials, delving into the mysteries of ultraviolet phenomena and the analysis of chemical compounds by infrared spectroscopy A section under Dr. Peter King was also established in 1944 to undertake a study of plastics, natural rubber and synthetic rubber. The latter work included the composition of various types of plastic armor in cooperation with the Electricity Division.

The work which could not be properly pigeon-holed into one of the established sections was given to a unit called Special Research Section (R. L. Tuve). This section invented two of the most novel chemical materials produced during the war. One was a "seamarker" dye used by shipwrecked seamen and aviators to color the sea so that they could be more easily spotted by searching aircraft. The other was a "shark chaser," a handy little chemical package containing materials which were offensive to the shark's sense of smell and taste. The same section also developed a new method of combatting oil tank fires by means of a foam injected near the bottom of the tank of burning oil.

The impact of the war highlighted two significant factors which should be noted in regard to the work of the Chemistry Division. The first was that the Navy had far more need for diversified chemical research than anyone had anticipated. The second was that most of the wartime contributions of the Division were, with the exception of Chemical Warfare and a few

other studies, of as much value to peacetime industry as they were to the Navy at war.

So, in the beginning years of the Chemistry Division, we find the following naval problems and needs were addressed:

(a) The need for protective coatings for naval aircraft, especially amphibious planes.

(b) Prevention of boiler corrosion by excluding oxygen from boiler feed water.

(c) The need for better rust inhibitive oils for steam turbines and other equipment.

(d) Elimination of submarine air pollution caused by hydrogen and stibine evolved by storage batteries and the CO and CO_2 evolved by crew and galley.

(e) The problems of lead cell battery design and corrosion in submarine service.

(f) The need for portable oxygen sources and rebreathers for use in firefighting aboard ship.

(g) Improvement in the storage stability of naval special fuel oil and aviation gasoline.

So, the first two decades ended with the Chemistry Division having solidly established itself with its many significant research accomplishments (Appendix H) and Division chronological staff adjustments (Appendix I).

III. The Third and Fourth Decade of the Chemistry Division 1950 - 1970

At this point, in the history of the Division, your author came on board as a naive youngster of 23 years. I reminisce, in an attempt to compile this history, how wonderful those 32 years have been! Can you imagine: (1) the numbers of people I have met and friends I have made; (2) the outstandingly significant research accomplishments I have seen start and finish; (3) that the cost of a person year's (use to be man year) support was $25.0K and is now over $100.0K; (4) being staffed in numerous antiquated buildings and now one huge laboratory - Building 207; (5) if the new Ph.D. knows what a "striker" and "bunsen burner" are; (6) typing a report on a word processor rather than a manual typewriter; (7) making copies of a letter in seconds instead of pulling, by hand, copies off a mimeograph machine in an hour; (8) laser chemistry instead of chemistry of storage batteries; (9) Ph.D. scientists who are not all males and clerical assistants who are not all females, etc? I am sure, with the modern technology of tomorrow, that whoever picks up this project in the future, he and/or she will be able to access a sophisticated computer to locate pertinent material to almost immediately complete their task; however, I can assure them they will not enjoy the many good chuckles that I have had doing this history in a manner they will consider "the hard way."

GENERAL INFORMATION (4)

During World War II the Chemistry Division grew rapidly, as shown by the number of personnel listed in Table 1, because the variety of military problems increased. During this period the Division was organized into Sections (later renamed Branches), and it rapidly matured into a modern technical organization. Besides an impressive number of significant accomplishments, some exciting possibilities for chemical research on new materials and new Naval applications were revealed; however, not all of these could be acted upon adequately during the war and were left to be attacked subsequently.

TABLE 1

Number of Personnel in Chemistry Division by Periods of Time

Beginning of World War II	25
End of World War II	228
April, 1946	117
August, 1952	149
August, 1965	123

After World War II there was a contraction of about 50% in Division personnel. The research program gave early emphasis to the important unsolved problems developed in the war; but increasing attention was given to exploiting new ideas and also to understanding the chemistry and materials evolved after the war. The availability of long-term funding from the newly created Office of Naval Research (ONR) allowed us to attack long-term research problems which appeared to hold much promise for the Navy needs. This source of funding became increasingly important to the Division as our funding by Navy bureaus gave increasing emphasis to materials and equipment having current or near-future interest; this trend was increased as more funds were diverted to larger end-item contractors. Hence, the proportion of ONR funds used by the Division and its Branches had increased. During the 1960's, approximately 50% of our funding came from ONR (Table 2).

TABLE 2

CHEMISTRY DIVISION FUNDING
1960 and 1967

SPONSOR	FY 1960 ($K)	FY 1967 ($K)
ONR General	1008.2	1661.1
ONR Special	-0-	28.0
NavShips	758.3	978.7
NavOrd/Air	291.5	403.8
NavFac	25.3	32.0
Special Projects	54.1	-0-
Deep Sub. Systems Proj.	-0-	65.0
NASA	65.7	-0-
AEC	40.0	10.0
ARPA	-0-	85.0
Army	21.5	-0-
Air Force	40.0	-0-
Panama Canal Company	23.0	-0-
TOTAL	2327.6	3269.7

During the Korean War the Division had innumerable opportunities to put to good use the results of our R&D effort in 1945-1950; but then we were very limited by the fact that new funds from Navy Bureaus were tied to the most immediate needs. During this war, increasing trouble was encountered with the operation and maintenance of many kinds of newly-designed equipment and materials under field conditions, especially the maintenance of equipment in the front areas or at advanced repair

bases. By the end of the war it was obvious much more attention was needed to increase reliability, simplify maintenance, and improve readiness in storage and field use of numerous types of military equipment. One committee survey reported that about a million men were needed behind the lines to keep 100,000 men operating effectively in the combat area. Because of this experience attention was focussed, in our Division program, on R&D and specification problems with fuels, lubricants, corrosion preventives, packaging readiness during storage, reliability of equipment and collecting atmospheric activity.

Much was accomplished with available resources (e.g., Dr. Peter King with Dr. Herbert Friedman, Head of the Electron Optics Branch, Optics Division, developed the "rainbarrel" method for detecting nuclear explosions at long range. Windborne bomb debris, brought down in rainfall onto roofs was drained into collecting tanks for analysis. This method successfully detected the first Soviet nuclear explosion in 1949).

KING and ZISMAN ERAS

Following the retirement of Dr. Parry Borgstrom in 1954, Dr. Peter King became the third Superintendent of the Chemistry Division (see Appendix C - Dr. King's Resume).

Figure 6 is a Division Staff montage at the time of Dr. King's Superintendency as well as the then-current Branch Head Staff.

Dr. William A. Zisman became the fourth Superintendent of the Division in 1956 when Dr. King was appointed as Associate Director of Research for Materials (see Appendix D - Dr. Zisman's Resume).

During the middle 1960's, eighty percent of the people of the Division had technical professional degrees and 28% had a doctorate. This high proportion of professionals was necessary for our diversified research program and for the kinds of tasks facing the Division. Their research was so directed as to allow the Division to serve in a general chemical supporting function to all material commands of the Navy Department and its field activities. The organization, personnel, equipment and philosophy of management enabled the staff to execute their job economically with appropriate dispatch and high Naval relevance while retaining a technically competent, interested, and reasonably stable group of investigators.

Much can be learned at this time by taking stock of the productivity of the Division and by inquiring about the causes. The Division's productivity in basic chemical research was summarized in 1965 in the report, "Basic Chemical Research in Government Laboratories," which discussed Government In-House Basic Research as part of the Westheimer Committee Survey of Basic Chemistry in the U.S.A. A natural assumption is that the Division's productivity was the result of the many demands made by the Navy in the period 1941 through the 1960's. Although it is true that there were many exciting or unusual demands made on the Division in this period of time, such a situation could and often did produce projects and kinds of productivity that we did not choose to boast about; there were occasional less fruitful investigations which consumed much time and money. The truth is that the most impressive products of the Division efforts usually resulted when our more talented and well-trained chemists were given the greatest possible freedom to choose their problems and seek answers by their own methods and routes. Adequate care was taken of the question of naval relevancy (i) by seeing to it that each investigator was kept fully aware of related naval needs, programs, and problems, and (ii) by arranging that the long-term or more fundamental investigations were carried out in the same task force (or branch) as those concerned with the more urgent or more relevant research.

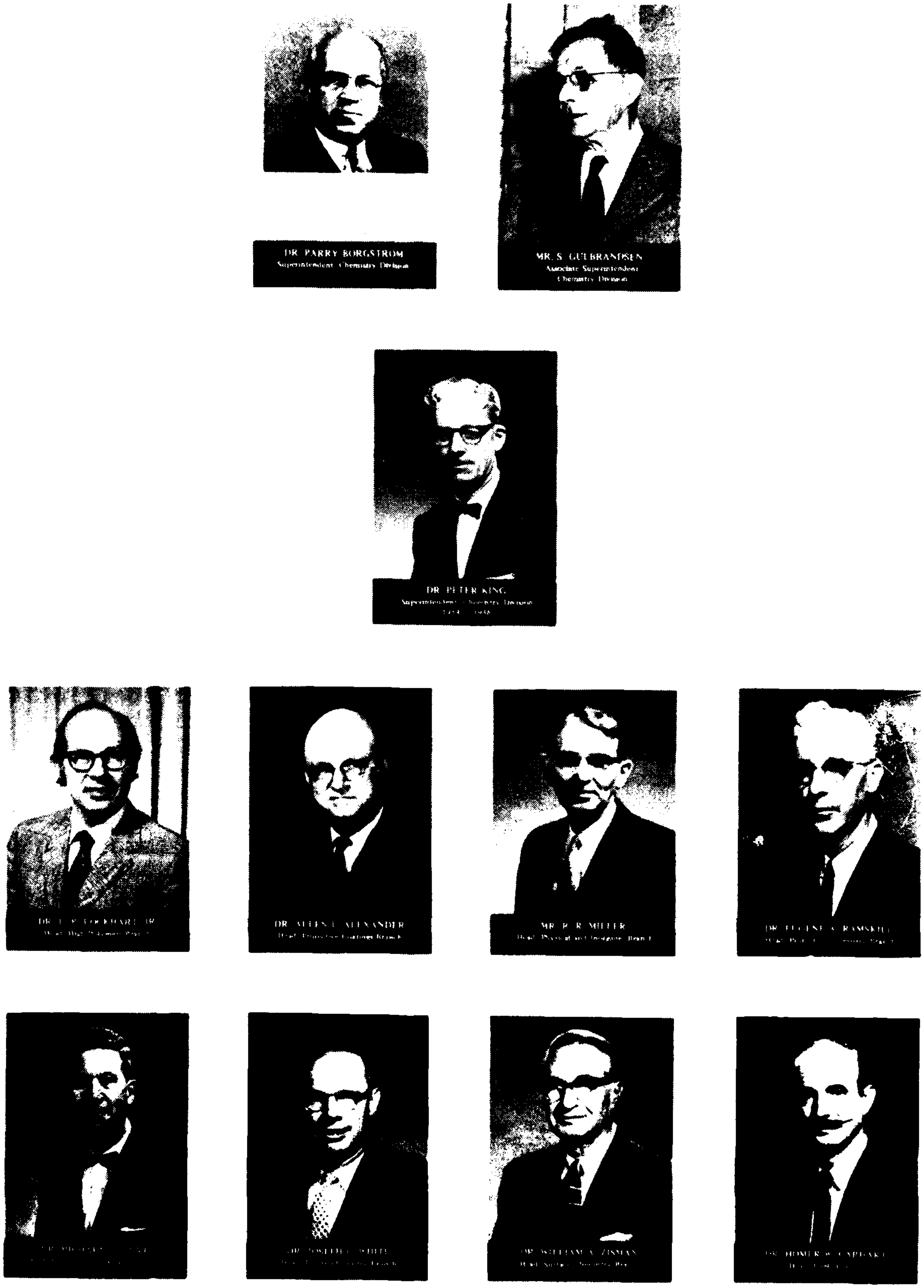

Fig. 6 — Division Staff Personnel — probably 1955.

Following are examples of the effectiveness of the approach on research:

a. The submarine life support program for nuclear submarines originated in a voluntary, modest investigation started by the Electrochemistry and Inorganic Chemistry Branches which later stimulated the Bureau of Ships R&D program on submarine life support even before the first nuclear powered submarine, the NAUTILUS, was launched. The resulting research program at NRL had been the key to the entire problem, and nuclear submarines and the Navy owe much to our Chemistry Division's alertness, aggressiveness, and competence.

b. The highly productive R&D program on synthetic lubricants originated from an exploration started by three of our chemists early during World War II, and it has continued since. The work originated because of their scientific curiosity about the relationship of liquid molecular structure to "oiliness" or lubricating qualities in hydrocarbon compounds. Their investigations and results have gradually revolutionized the field of lubrication, especially for use in military and civilian aviation, ordnance, and instrumentation. As a result, the NRL team has been recognized for 20 years as one of the world's two great lubrication and friction research teams (the other being at Cambridge University, England).

c. The first filter paper from ultra-fine glass fiber and later filter papers from ultra-fine organic fibers grew out of an NRL Chemistry exploration into the art of making paper for use in gas masks. This investigation was a self-initiated, unheralded, and most competent adventure into the field involving the art of paper making and its relation to gas filtration and fiber matte structure. This NRL effort gave chemical warfare defense a big boost, for such paper is now used in all the Armed Forces gas masks; it also was a source of much interest and stimulation to industry. Incidentally, our filter paper research caused a later industrial effort which resulted in the familiar filter-tipped cigarettes.

d. The extraordinary low adhesional and low frictional properties of thin coatings of Teflon (and of a variety of other later fluorocarbon compounds) grew out of an extended physical chemistry investigation initiated in the Division to explore the then unknown area between surface chemistry and organic fluorine chemistry. Although the initial phases of the work were not directed to any relevant naval need, they soon led directly to hundreds of naval applications as well as world-wide interest and use.

There are many more examples proving that the most productive research efforts in the Chemistry Division, like those of the entire NRL, did not arise from attempts to perfect known

military hardware or military systems. Our major productivity was the result of laboratory-initiated attempts to advance knowledge and naval practice at the frontiers of science and engineering. However, because the majority of investigators knew, or were associated with those who knew, much about Navy Department needs and problems, there was an astonishingly rapid transfer of the research ideas and results to Navy Department groups responsible for R&D, maintenance, production, and Fleet needs.

Highly qualified and experienced mission-oriented R&D teams have been assembled readily. A unique character of these specialized groups is their ability to cut across boundaries that are created by academically defined scientific disciplines or by industries whose conservatism, product orientation or specialization resist change. This feature is especially well shown by our effort of the past years on submarine life support; the current work on reinforced plastics; the STOPS ship protection program; and the ARPA stress corrosion-cracking program.

On the basis of past NRL experience we can predict that the accumulated chemistry R&D know-how at NRL will be used again and again to help naval activities including many not responsible for the initiation or support of the original research effort.

SPECIFIC RESEARCH INFORMATION (5)

Some of the Division programs were interdisciplinary and crossed several branch lines. Four such major programs existed: the Submarine Life Support program; the ASW and Reinforced Plastics programs and the Corrosion Mechanisms problem.

The Submarine Life Support Program included research, development and troubleshooting on the effects and control of contaminants in the atmospheres of nuclear submarines. The effort involved the research on and development of shipboard-reliable equipment for monitoring and controlling the predominant trace gases in submarine atmospheres, and also included much time-consuming analytical research ranging from chemical sleuthing during submerged submarine operation to studies of a great number of samples of air and materials of construction.

NRL accomplishments, in this time period, included: the design, manufacture, and installation of composite atmosphere analyzers on the first four nuclear submarines, which were replaced by the commercialized versions (the Mark III and Mark IV analyzers); the development of the carbon monoxide/hydrogen burner and accompanying research which demonstrated its combustive capability for various kinds of hydrocarbons as well; conducting of exhaustive catalytic combustion studies in the laboratory which helped to solve many of the shipboard problems encountered; the development of a gas leak detector based on the

thermal conductivity Wheatstone bridge; the development of a total hydrocarbon analyzer; the development of a prototype gas chromatograph atmosphere analyzer; an increase of from 1000-2000% since 1957 in the capacity of electrostatic precipitators for removing aerosols; the development of nontoxic, interior, semigloss latex paints; the demonstration of the excessive power requirement required for an algal oxygen production and carbon dioxide absorption system; and the development of the sulfate cycle system for oxygen generation and carbon dioxide absorption.

Future work was to include analytical research, improvements in the NRL-developed shipboard equipment, and efforts to develop an integrated system for all air purification equipment.

Funding data (for this program) by the various bureaus in 1960, appeared approximately as follows:

BuShips	$340.6K
Spec. Proj.	54.1K
ONR	74.0K

The Anti-Submarine Warfare Program included studies of surface properties of the ocean which might be relevant to detection of submerged submarines. The general approach was divided into two major areas of investigation: (a) laboratory and field studies of the basic chemical and physical properties of the ocean surface with particular emphasis on the origin, nature and properties of materials which can give rise to wave damping, and (b) field studies of the surface consequences of submarine movement which could modify the distribution or properties of such materials.

Methods were developed for sampling and analysis of surface-active materials contained in sea water or adsorbed in the upper 150 microns of the water surface. Widely separated samples from the Atlantic and Pacific Oceans and bordering seas show that such materials are of natural origin and are present in sufficient concentrations to allow formation of visible slicks when the environmental conditions were appropriate. Detailed studies of the physical properties of these materials clearly indicate that wave slope and surface temperature may be profoundly affected by lateral movement of the underlying water, where the initial concentration of surfactants is optimum.

Field studies showed that measurable lateral movement of the surface results from submarine passage at relatively shallow depths. In several cases, modification of the wave structure had been observed as predicted. Local wind or natural water convergence, however, often overwhelm the effects generated by the submarine and work is in progress to more accurately describe these natural phenomena. Photographic techniques for

detection of wave slope anomolies were developed. Specific future plans were contingent on a reassessment of progress to approximately 1966. It was anticipated that future work would move in the direction of developing more accurate descriptions of the detailed effects of the wind/sea interaction and the development of means for time-coherent display of the resulting phenomena to permit separation of the submarine generated effects from the natural background. (Initial funding was made by BuShips; later wholly funded by BuWeps, approximately $250.0K in 1966. In approximately 1967, this program and some of the scientists were transferred to the newly established Ocean Sciences and Engineering Division.)

The Corrosion Mechanisms Program was oriented toward the analysis of the mechanism of corrosion in ferrous systems under conditions pertinent to steam power generation. A study of the various compounds which could be generated in such systems and their protective value as films has established that reliable protection was obtained only by the development of Fe_3O_4 films which have the spinel structure. Boiler operations are conditioned by the development, preservation and breakdown of these films. It has been shown that a slight alkalization is desirable but that the use of either sodium or potassium hydroxide for alkalization could induce boiler tube pitting at high steaming rates.

It was shown that aqueous solutions of lithium hydroxide behave quite differently from aqueous solutions of sodium or potassium hydroxide in their reactions with steel in high temperature aqueous systems and there is some evidence that the use of lithium hydroxide for alkalization in place of sodium or potassium hydroxide may solve the pitting problem. Further work was to be done on the mechanism of spinel film breakdown under conditions pertinent to steam power generation, and on the corrosion inhibition which may be effected by incorporation of lithium and other substituents in spinel films (this program was transferred from the Metallurgy Division in 1963 and upon the retirement of Dr. M. C. Bloom in 1968 portions of this program were transferred to the Inorganic and Chemistry Branch and the Surface Chemistry Branch (sponsored funding, 1966: BuShips, $96.5K).

PHYSICAL CHEMISTRY BRANCH PROGRAM

The program of the Physical Chemistry Branch was divided into two principal elements. These were as follows:

Atmospheric Radioactivity Studies - The behavior of radioactive particles in the atmosphere as a function of the source, the site of introduction, and various meteorological parameters was studied by appropriate sampling and analytical techniques. The atmosphere normally contained a variety of radioactive products of natural origin to which had been added

in recent years varying amounts of the products of nuclear fission or fusion. These radioactive materials could be used as tracers for meteorological processes, including interhemispheric mixing, meridional circulation patterns, stratospheric and residence times, stratosphere-to-troposphere interchange, etc., and, in the case of the artificial radionuclides, could also be employed to obtain information about the nuclear event producing them. Knowledge of the behavior of the fission products, in particular, is required in order to adequately guard against their effects on personnel (sponsored funding in 1966: ABC Sunshine Program, $40.0K; ONR, $13.0K).

Molecular and Mass Spectroscopy - The techniques of infrared, visible, ultraviolet, Raman, nuclear magnetic resonance and electron paramagnetic resonance spectroscopy and mass spectrometry were employed in basic studies of molecular structure and chemical bonding and for analytical and diagnostic purposes. Each of the various spectroscopic techniques covers an area where it is uniquely qualified to give information on molecular structure and chemical constitution that is required for a better understanding of chemical systems and their more successful exploitation in Naval applications. In addition to basic studies leading to a better comprehension of the scientific principles involved in atomic and molecular interactions and to the development of new methods and techniques, these facilities permit a direct contribution to problems of Naval interest through joint research projects involving their use as diagnostic or analytical tools (sponsored funding, 1966: NASA, $50.0K; ONR, $196.0K).

ORGANIC AND BIOLOGICAL CHEMISTRY BRANCH PROGRAM

The program of the Organic and Biological Chemistry Branch was divided into four principal elements:

Organic Coatings - the work on organic coatings was, for the most part, with materials of a functional nature. They have included organic coatings to control emissivity and reflectance in space vehicles; linings for sealing and protecting the interior of fuel storage systems; fluorescent paints; and non-toxic latex materials for submarine interiors. Each of these products had been expressly requested by one of the bureaus of the Navy Department or some other government agency in answer to a specific problem. In addition to materials whose end-use was already defined, considerable work was done on the mechanism of film-formation from drying oils and their subsequent degradation (sponored funding FY 1966: BuY&D, $25.0K; ONR, 1966, $35.0K; BuShips, 1966, $24.0K).

Polymers - In this area, concern was not with the synthesis of new polymers with novel properties, but rather studying the mechanisms of polymer stabilization and subsequent deterioration under degrading influences. Also, there was an

interest in polymers which were photodegradable for unique applications. The properties of inorganic polymers made them somewhat unique and were being investigated with a view to developing heat-stable materials. A major effort was directed toward the improvement of filament-wound composites. In every instance the scientists were defining the properties of polymers under study as they defined the areas in which they may be used subsequently (sponsored funding FY 1966: BuWeps, $15.0K; NASA, $25.0K; ONR, $53.0K; ONR(Special), $27.0K; BuShips, $100.0K, S.P., $62.0K).

Biochemistry - This field was entered initially as a result of the general biodegradation of many types of materials used in the tropics. Studies have included the physiology of specific strains of fungi and their surface properties which in turn may furnish clues to better controlling techniques. Microbial degradation of hydrocarbon fuels is a matter of concern and is being intensively studied. Recent years demonstrated the feasibility of a photosynthetic gas exchanger using a selected strain of alga as a means of balancing CO_2 against oxygen in closed systems. The preservative qualities of creosote have been investigated and some effort was devoted to protein systems so that some fundamental questions as to their structure could be clarified (sponsored funding in 1966: ONR, $150.0K; BuWeps, $55.0K; this program was transferred in 1966 to the newly established Ocean Sciences and Engineering Division).

Elastomers - Work on elastomers had been reduced by 1965-66. A requirement for low friction elastomers was largely supplied by the Branch group working on "lubricated" rubber, through a judicious application of Teflon to the surface. A study of recording belts in a cooperative project with the Radar Division showed a vast improvement over any material presently available from commerce (sponsored funding, 1966: ONR, $29.0K; BuShips, $40.0K).

INORGANIC AND NUCLEAR CHEMISTRY BRANCH PROGRAM

The major program or research in this Branch was divided into two phases of endeavor:

High Temperature Properties - This is the study of the chemical and physical properties of materials at high temperature. This study is centered on the use of liquid alkali metals as heat transfer media for cooling or energy conversion to 1400 C (sponsored funding, 1966: ONR, $195.0K).

Breathable Atmospheres - This program is research and development in connection with the production and maintenance of breathable atmospheres. The problems deal with research and

development inherent in the production and maintenance of suitable breathing atmospheres for normal breathing in close spaces and masked breathing in unbreathable atmospheres (sponsored funding, 1966: ONR, $46.0K; BuShips, $87.0K).

PROTECTIVE CHEMISTRY BRANCH PROGRAM

The major program of this Branch is CW/BW Ship Defense and the tasks were divided into: Adsorbents, Microbial Surfaces,and BW/CW Ship Defense.

CW/BW Ship Defense - The potential use of chemical (CW) and biological warfare (BW) agents in modern warfare required that the Fleet possess the capability to operate in such environments. Because of the lack of completely satisfactory means of defense, the forces afloat now have such a capability to a very limited extent. It is, therefore, mandatory that methods and materials be developed which will insure timely detection and identification of toxic agents, adequate individual and collective protection, and rapid and effective decontamination (sponsored funding, 1966: BuShips, $190.0K; ONR, $139.0K; AEC, $30.0K; White House, $5.0K).

ELECTROCHEMISTRY BRANCH PROGRAM

The program of the Electrochemistry Branch can be divided into three elements: Batteries, Electrode Processes, and Submarine Atmosphere Control.

Batteries - Optical and electron microscopy, X-ray and electron diffraction techniques are being used in conjunction with a number of electrochemical measurements to study both the lead-lead oxide system in sulfuric acid and the silver oxide-zinc system in alkaline solutions. Methods were being developed which should considerably reduce the amount of experimental data required to design batteries of optimum performance for specific applications (sponsored funding, 1966: ONR, $133.0K; BuShips, $30.0K).

Electrode Processess - A fundamental approach is directed towards understanding the kinetics of the electrode reactions which are essential for better utilization for many electrochemical processes, such as in corrosion, batteries, fuel cells, electroplating, electropolishing, electrochemical preparations, and electrotwinning (sponsored funding, 1966: ONR, $53.0K; BuShips, $55.0K).

Submarine Atmosphere Control - Methods are being studied for the analysis and control of the atmosphere in nuclear submarines. A continuous effort was being made in an attempt to improve as well as to develop new and more efficient methods of analysis and control of the atmosphere of nuclear powered submarines (sponsored funding, 1966: BuShips, $40.0K).

SURFACE CHEMISTRY BRANCH PROGRAM

The programs of this Branch consist of five major elements, as follows: Surface Chemical Studies, Friction and Wear, Lubricant Liquids, Colloids, and Corrosion Inhibition and Chemical Cleaning.

Surface Chemical Studies - Surface chemical studies establish basic surface chemical phenomena and principles which are expected to assist in the solution of naval technical problems in the fields of lubrication, corrosion control, adhesive bonding, equipment cleaning, submarine detection, and ice release. Naval applications stemming in whole or in part from these surface chemical studies include systematic explanations of how polar-nonpolar additives in oil prevent rusting, improve boundary lubrication, and sometimes produce nonspreading oils; the development of powerful displacing agents for bulk water and oil from naval electrical equipment; the application of thin Teflon films as dry lubricants; fluorinated additives to reduce the friction of plastics; and fluorocarbon resin films as barriers to lubricant loss from miniature bearings (sponsored funding, 1966: ONR, $136.0K; BuWeps, $105.0K).

Friction and Wear - The objective of this work is to provide new basic understanding of friction and wear effects that will lead to better lubricants, better design of bearing elements and greater reliability in naval equipment. The work of this group revealed the poor lubricity of silicone liquids, demonstrated the durability of adsorbed monolayers of polar-nonpolar molecules as boundary lubricants, established the direct correspondence between low surface energy and low friction for polymeric materials, and discovered the very low friction and the unique lubricant utility of very thin polytetrafluoroethylene (Teflon) films on hard substrates (sponsored funding, 1966: ONR, $51.0K; BuWeps,$65.0K).

Lubricant Liquids - This group conducted fundamental studies on oxidative and thermal degradation of lubricants, and oxidation inhibitors. It determined the properties of synthetic lubricants and designs and formulated lubricants for special military applications. The objectives of the work were to provide reliable information on the physical properties and the stability of new synthetic lubricants, to find suitable oxidation inhibitors for such lubricants, and to formulate lubricants for exacting naval requirements (sponsored funding, 1966: ONR, $50.0K, BuWeps, $149.0K).

Colloids - This section studied the physical chemistry of oil-soluble soaps, colloid structures in greases, and drag reduction by macromolecular colloids in dilute solutions. Its objectives were to improve fundamental understanding of colloid phenomena in both nonaqueous and

aqueous systems, and to relate this knowledge to the performance of oil-soluble soaps as rust inhibitors and engine detergents in military lubricants, to the control of grease properties, and to the reduction of turbulence losses of water borne vehicles (sponsored fundging, 1966: ONR, $136.0K).

Corrosion Inhibition and Chemical Cleaning - This element studied corrosion inhibition by polar-nonpolar additives in lubricants, vapor type corrosion inhibitors, design of greases for special military uses, and techniques for the reconditioning of electrical equipment after flooding and/or corrosion. It also furnishes consultative service to the operating bureaus (sponsored funding, 1966: ONR, $32.0K; BuShips, $66.0K).

FUELS BRANCH PROGRAM

The Fuels Branch program was to study (1) petroleum fuel properties that affect use and handling; (2) ignition and combustion of hydrocarbons, including effect on safety; and (3) the synthesis of nitrogen fluorides by high energy particle bombardment.

Fuels - Fuels studies were (a) to help achieve the delivery to jet aircraft of ever better quality fuels by study of their pertinent chemical and physical properties, of effects of composition, especially the presence of contaminants including dirt, water, microbes and surfactants, and of means for assessing and controlling these; and (b) to develop a monitor that would give a reliable and continuous measure of sea water content of Navy Special fuel oil as it is fed into ships' boiler burners, to study means for removing this water and, later on, to study the effects of fuel composition on the formation of slag on the fire-side of boilers.

Ignition and Combustion - To establish the interrelationships of the physical properties of hydrocarbons and fuels with the flammability characteristics that are used as measures of safety, and the significance of these; to determine the factors affecting generation and decay of electrostatic charges that are built up during transfer of fuels and to evaluate the incendiary nature (or lack of it) during sudden spark discharges that occur on the surface of the fuels; and to study the formation and behavior of ions during catalytic combustion and its potential as a detector for gas chromatography.

Nitrogen Fluorides - To develop novel methods for the synthesis of compounds, particularly the nitrogen fluorides and other light element compounds, from simple starting materials by bombardment with nuclear fission products or electrons in a plasma jet (sponsored funding for all programs in this Branch, 1966: ONR, $95.0K; BuWeps, $70.0K; BuShips, $60.0K).

CONCLUSION OF THE SECOND TWO DECADES

The period between Dr. W. A. Zisman's retirement in February, 1968, and the appointment of his successor, Dr. Ronald E. Kagarise, which occurred in early October 1968 (Appendix E - Dr. Kagarise's Resume), was a rather trying and unsettled period for the Division. Long range plans and decisions were held in abeyance, pending the installation of the new superintendent. From October, 1968, to approximately April, 1969, considerable effort was devoted to assessing the Division's present position and to the establishment of strengths and weaknesses. Programmatic and personnel changes were initiated commencing 1 July 1969.

A memorable and significant event occurred on 18 July 1968, when ground was broken for the new Chemistry Laboratory, which was scheduled for completion during the summer of 1970. The construction of this building represented the culmination of a long and difficult struggle on the part of many people and we shall always be indebted to them for their tireless efforts (e.g., the Chemistry Division had a Long-Range Planning Committee that was formed in September 1958 and the members were Dr. W. A. Zisman, Chairman, Dr. A. L. Alexander, Dr. E. A. Ramskill Mr. V. R. Piatt and Mr. J. A. Grand (due to the untimely death of Joe Grand, Mr. C. M. Murphy succeeded him). It should be noted that the conception and actualization of our present laboratory building (Building 207) was carried out largely during Dr. Zisman's tenure. Dr. Zisman was given the honor of officially breaking ground for the new Building and he expressed, at that time, the Division's deep appreciation of RADM T. B. Owen's (former Director of NRL) and Captain J. C. Matheson's (at the time, current Director of NRL) efforts on behalf of the building (further information is available in LABSTRACTS, 26 July 1968).

Appendices H-1 and I-1 represent the Division's Significant Accomplishments and staff changes from 1950 through 1969 (these are chronological continuations of Appendices H and I, respectively).

IV. The Fifth Decade Plus Two Years of the Chemistry Division - 1970 - 1982 (6)

KAGARISE ERA

From the latter part of 1968 through the beginning of 1970, organizational and programmatic changes had been extant but at a subdued level of activity. Rather, emphasis had been placed on encouraging the growth and solidification of newly initiated programs such as efforts in ceramics, cool flames, chemical lasers, drag reduction, and organic synthesis.

Dr. Kagarise had been on board, as Superintendent, for a little over a year when he stated, "During the 1970's we will enter a decade of increased retirement activity. By the end of 1975, 50 members of our staff as it existed in 1968 (when Dr. Kagarise was appointed Superintendent), will have become eligible for retirement. Clearly, the personnel makeup of this Division will change markedly. Thus, an unusual opportunity exists to drastically reshape the research program of the Division." How right he was! We were very shortly confronted with the replacment of many of the Branch Heads who had been appointed to the Division very early in its history and were contemplating their retirement. These major personnel changes commenced as follows:

1969 - Dr. C. R. Singleterry who had achieved a worldwide reputation for his research on colloids and lubricants, replaced Dr. W. A. Zisman as Head of the Surface Chemistry Branch in 1956, and during 1969 Dr. Singleterry retired. Dr. N. L. Jarvis who had been on the staff of the Laboratory for Chemical Phsics and worked in close collaboration with Dr. Zisman replaced Dr. Singleterry as Branch Head

1970 - In July, 1970, Dr. E. A. Ramskill retired after having served as Head of the Protective Chemistry Branch for approximately 30 years. During his tenure, the Branch rose to a position of pre-eminence in the field of defensive biological and chemical warfare. However, after the Navy decision to consolidate it's defensive BW/CW activities at a single facility, NRL rejected an offer to assume responsibility for this role, mainly on the grounds that the overall program was oriented towards advanced development and engineering, in conflict with our historical emphasis on research and exploratory development. Therefore, in view of an anticipated declining involvement in the BW/CW area, the Branch was disestablished following Dr. Ramskill's retirement. Individual sections were kept intact and assigned to Branches having missions most compatible with the programs and interest of the sections involved.

1970 - Following the establishment of the NRL Environmental Pollution Control Staff, Mr. V. R. Piatt the Division's Scientific Staff Officer, left the Chemistry Division to become NRL's first Environmental Pollution Control Officer and Head of the Staff. Following the early 1971 retirement of Mr. J. N. Scudder, Supply and Equipment Specialist for the Division, Mrs. J. R. Kahler (who had formerly been Dr. Ramskill's secretary) was appointed the Division Supply Technician assuming the administrative duties relating to the Supply and Equipment area.

1971 - This year started with the retirement in January, 1971 of Mr. R. R. Miller, Head of the Inorganic Chemistry Branch. Nearly thirty-five of Mr. Miller's forty-one years of Government service were spent at NRL, and his contributions to the Navy were both numerous and far-reaching. We initiated a search for an adequate replacement for Mr. Miller and the final selection, after many months, was Dr. William B. Fox who came from the Allied Chemical Corporation. Dr. Fox brought with him plans to establish a strong program in the area of advanced inorganic materials, with particular emphasis on fluorine stabilized compounds. Progress for this program was certainly delayed primarily due to the hiring freeze and the acquisition and assembling of sophisticated experimental facilities required for the conduct of fluorine chemistry.

1971 - Effective May 1971, Dr. J. C. White, Head of the Electrochemistry Branch retired. "Doc White" (as we all called him) had headed this Branch for almost thirty years and his capable leadership of this Branch attained a level of productivity and international recognition out of all proportions to the relatively small size of his group. It came as no great surprise, therefore, that a diligent, nationwide search for an adequate replacement for him, revealed that the best talent was already in hand - Mr. Sigmund Schuldiner, a senior member of this Branch and one of the Division's more productive researchers. During this same year, Mrs. J. Burbank, a stalwart member of the Electrochemistry Branch and recipient of the sixth biennial William Blum Electrochemical Prize (1969) and the 1970 Frank Booth Award, retired to Arizona.

We started preparing for the Dedication and Acceptance Ceremony of Building 207 in 1970 and started physically moving the Division employees and equipment into 207 the first part of 1971 (Figure 7 - photograph of Building 207). Needless to say, one cannot dismantle, transfer, and reassemble complex scientific instruments without delays, damage and disruption of research programs. However, moving did provide a once-in-a-lifetime opportunity to discard obsolete and worn-out equipment, unwieldy vacuum racks, surplus chemicals, "dead" files, etc.

On Thursday, 9 September 1971 at 11:00 a.m., the official Dedication and Acceptance Ceremony took place (Figure 8) It was a grand affair! There was a detachment of the Navy Band on hand

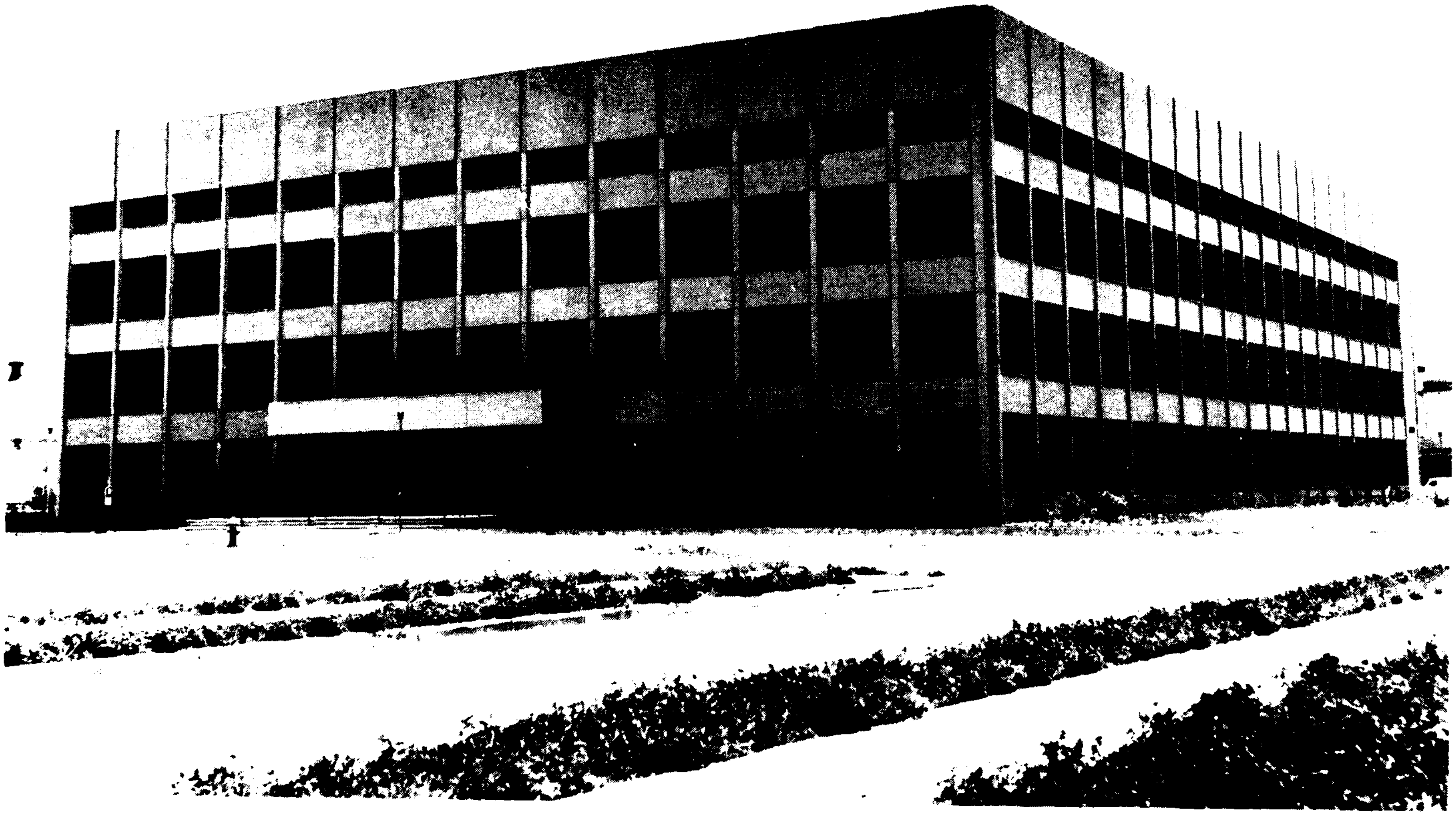

Fig. 7 — The New Chemistry Building, 207, FY 1971.

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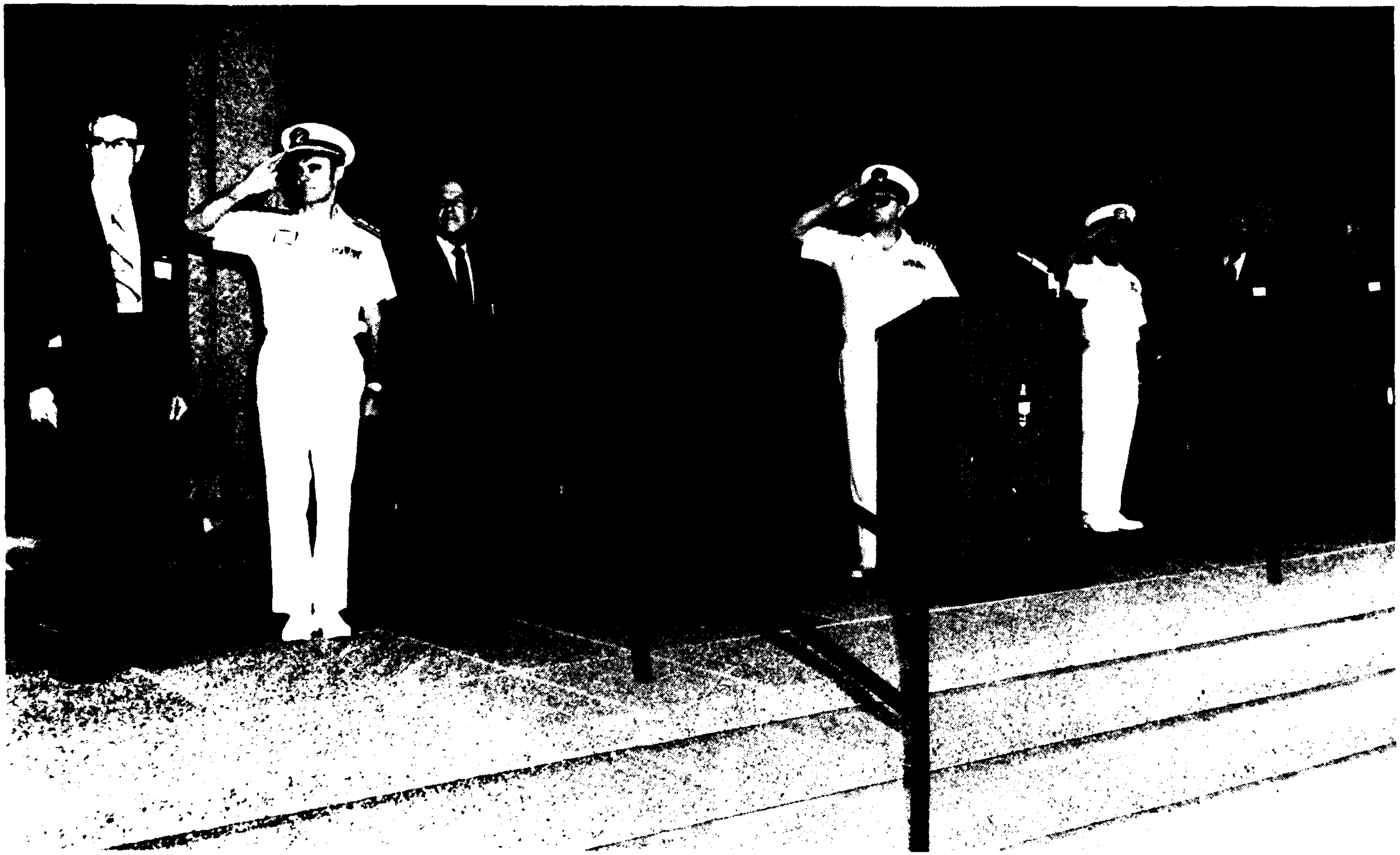

Fig. 8 — Official dedication and acceptance of Building 207 — 9 September 1971.

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to provide appropriate music and many notable guests including: Captain E. W. Sapp Director of NRL; RADM W. M. Enger, Commander, NAVFAC; Captain Van Leer, Commander of Chesapeake Division of NAVFAC (who presented the building to the Laboratory); Dr. A. Berman, Research Director (who accepted the building on behalf of the Laboratory); Dr. R. A. Frosch, Assistant Secretary of the Navy for R&D; and RADM C. O. Holmquist, Chief of Naval Research. Dr. M. Harris, Member, Board of Directors, American Chemical Society, gave the principal address to which a response was given by Dr. W. A. Zisman, Head, Laboratory for Chemical Physics, and Dr. R. E. Kagarise, Superintendent of the Chemistry Division, closed the formal ceremony. At 12:00 noon a buffet luncheon for guests and all members of the Chemistry Division was served in Building 207 (just to keep the records straight - the lunch was not paid for with Government funds). An Open House was held from 1:00 p.m. through 3:30 p.m. The competency, cooperation and devotion displayed by Chemistry Division personnel, notably our secretarial staff, resulted in a highly successful and memorable dedication event in keeping with the finest traditions of NRL.

With the dedication over, we tried to get back to work and simultaneously get ourselves established in the new building (but our new building wasn't enough incentive to deter the retirements nor slow down the personnel changes, as you will see).

1972 - Less than a year later brought the retirement of Dr. A. L. Alexander, Head of the Organic Chemistry Branch, Code 6120, and an employee of the Chemistry Division since 1938. Dr. Alexander had achieved an international reputation in the areas of organic coatings, corrosion, and in the general area of the prevention of material degradation. Dr. J. Enoch Johnson Head of the Distillate Fuels and Combustion Section, Chemical Dynamics Branch (Code 6180), Chemistry Division. was selected to replace Dr. Alexander. Dr. Johnson had for many years made and directed continuing fundamental studies into many aspects of the oxidation reactions of organic compounds.

While these retirements were occurring, I think it only fair to indicate that by 1972 we acquired as full-time hires (among others): Drs. R. DeMarco, O. K. Kim, M. C. Lin, J. McDonald, J. Murday, and R. Sheinson. Then came Phase I of President Nixon's Economic Program and with it a series of instructions and directives which curtailed most hiring actions. The Chemistry Division did, however, maintain its momentum in the NRC Resident Research Fellowship Program (now the Cooperative Research Associateship Program (CRA))by the selection of ten appointees (it is interesting that after completing their appointments, only one postdoctoral associate was hired by the Division (Dr. J. J. DeCorpo) and just this year he left NRL for an appointment at NAVSEA; however, since the inception of the CRA in approximately 1955, the use of this Program as a hiring

source equates to 50% of the total number of appointees. A major influx of personnel occurred when the nine-man staff of the Combustion Suppression Research Center was reassigned as the Fire Suppression Section in our Chemical Dynamics Branch.

The research and development program of the Division initiated significant programmatic changes. For example, involvement in the High Energy Laser Program which was nonexistent in FY70, reached an estimated level of $180.0K (4MY) in FY72. External support for ceramics research also exhibited spectacular growth, increasing from zero in FY70 to approximately $200.0K in FY72. This influx of support permitted us to shift 6.1 ONR funds to support the establishment of Code 6130's advanced inorganic materials. The importance of and continuing interest in fire research was manifested by $230.0K growth in support over the past two years. Unhappily, we had been unable to recruit the manpower needed to fulfill this increased commitment. On the negative side, support had declined in the areas of lubrication and atmosphere control.

Following herewith and broken into three major subject areas, to demonstrate the overall character of the program objectives, is abbreviated information on the research and development program of the Division during the "Kagarise Era".

MATERIALS RESEARCH - (Polymers; Oils, Fuels, and Lubricants; and Inorganic Materials) -The diversity of individual projects listed under this heading share the common objective of providing the Navy with improved materials capable of withstanding the severe environmental conditions imposed by extremes of temperature, pressure, electromagnetic radiation, etc. Approximately one half ($2.3M) of the Division's total effort was applied to materials research, the bulk of this dealing with polymeric or organic substances. However, the rapid expansion of our ceramics program and the establishment of an advanced inorganic materials effort should establish a better balance in the future.

ANALYSIS AND CONTROL OF ATMOSPHERES - (Submarine Atmospheres; Emergency Breathing Problems; and Fire Research) - The maintenance of life-sustaining atmospheres is of critical importance to the fulfillment of virtually all Naval missions. The most noteworthy examples are the nuclear submarine and high altitude aircraft where one is confronted with completely artificial or man-controlled atmospheres. The hostile environments created by BW/CW agents or unwanted fires also present challenging habitability problems. The Chemistry Division has had a continuing and distinguished involvement in this area, ranging from the development of chemical sources of oxygen (chlorate candles and potassium superoxide) to the analysis of trace contaminants at concentrations of parts per billion.

ENERGY CONVERSION - (Electrochemistry and Corrosion; and Chemical Dynamics) - The generalization and utilization of

energy is central to virtually every Naval activity. It is not surprising, therefore, that a large segment of the Navy's R&D effort is devoted to the search for new sources of power, such as controlled thermonuclear fusion, or more efficient techniques for the conversion of energy from one form to another, e.g., fuel cells, magnetohydrodynamics, thermoelectric devices, etc. Imbedded within the total research program of the Chemistry Division are a number of projects devoted to the study of the conversion of chemical energy to such forms as electrical (batteries and fuel cells), mechanical and/or thermal (combustion engines) and electromagnetic (chemical lasers). Obviously, this rather modest effort (25 MY) could not effectively contribute to every facet of chemical energy conversion. However, by concentrating our efforts in selected areas, significant progress was possible.

After having looked at the above broad program areas, in approximately 1972, subdivisions by Sections showing more specific areas of Branch research and listing the names of the Section Heads, are found in Appendix J.

1973 - Fiftieth Anniversary of NRL!

1974 - After more than 32 years service in the Chemistry Division, Dr. J. E. Johnson, Head of the Organic Chemistry Branch retired in February, 1974. Dr. Johnson had developed special competence and earned international recognition in several areas of organic chemistry, i.e., fields related to all aspects of combustion and air purification. Dr. L. B. Lockhart, Jr., because of his demonstrated exceptional managerial skills and high performance standards as well as his considerable training as an organic chemist, was reassigned from Head of the Physical Chemistry Branch (Code 6110) to Head of the Organic Chemistry Branch (Code 6120).

Dr. F. E. Saalfeld, Head of the Mass Spectroscopy Section, Physical Chemistry Branch (Code 6110), Chemistry Division, was selected to replace Dr. Lockhart as Head of the Physical Chemistry Branch (Code 6110). Dr. Saalfeld's proven maturity, drive, versatility, exceptional activity in professional societies, and the rapid growth of his Mass Spectroscopy Section, had shown competent leadership both in the technical and administrative areas.

1975 - At this period in time, Dr. R. E. Kagarise was offered and he accepted the position of Director for Materials Research at the National Science Foundation; the Division programs and personnel had changed significantly, appropriately keeping up with the needs of the Navy; the total budget approximated $6.0M.

In his "Farewell Comments," Dr. Kagarise said, "Events of the past seven years have been an odd mixture of opportunities,

challenges, rewards, frustrations and disappointments. Above all else, it has been a period of change: personnel-wise, program-wise and policy-wise. Some of these changes have been for the better and have enabled us to institute more timely and more productive research programs, to promote staff members to positions of higher responsibility, and to recruit a cadre of exceptionally capable young people. I am confident that the Division has the technical competence, program balance, resilience and adaptability to cope with all disruptive forces. Hopefully, this can be accomplished and still maintain acceptable levels of productivity, since the long-term health and welfare of the Navy depends upon competent and productive in-house laboratories such as NRL!"

SAALFELD ERA (7)

Following the transfer of Dr. Kagarise, the various Division Branch Heads rotated as Acting Superintendent until such time as the the nation-wide selection was made for the position.

In March, 1976, Dr. F. E. Saalfeld, Head, Physical Chemistry, Chemistry Division, was appointed Superintendent of the Division (see Appendix F, Dr. Saalfeld's resume) and following the normal selection process, in 1977, Dr. A. B. Harvey, Head of the Chemical Spectroscopy Section, Physical Chemistry Branch, Chemistry Division, was appointed Head of the Physical Chemistry Branch. Dr. Harvey had directed a productive group of scientists in areas of chemical laser research, molecular energy transfer and molecular spectroscopy.

An overview of the Division, as it appeared just after Dr. Saalfeld's first year of tenure, is as follows:

The Chemistry Division was organized into five (5) Branches: Physical Chemistry, Code 6110; Organic Chemistry, Code 6120; Inorganic Chemistry, Code 6130; Surface Chemistry, Code 6170; and Chemical Dynamics, Code 6180. The Physical Chemistry Branch conducted characterization research such as optical diagnostics and chemical kinetics. The Organic Chemistry Branch dealt primarily with the syntheses and understanding of polymeric materials. The Inorganic Chemistry Branch had efforts in the syntheses of new fluorine compounds and in aqueous chemistry. The Surface Chemistry Branch dealt with various aspects of the interfacing between various phases of matter. Finally, the Chemical Dynamics Branch worked with combustion and fuels. Fifty percent of the Chemistry Division's staff were Ph.D's. This directly resulted from the very large number of diverse projects underway in the Division. The diversity of the Chemistry Division is indicated by its funding. In FY76 the Division had approximately 40% 6.1 ONR in-house funds which provided a very strong technology base for applied projects. The remaining Division funds were divided as follows: 18%, 6.2 (exploratory development); 11%, 6.3 (advanced development); and

32%, "other." A great percentage of these "other" funds were for O&MN type problems such as the emergency analysis of submarine atmospheres.

The three most pressing problems were: hiring, promotions and paperwork. The hiring restrictions were difficult and made it almost impossible to obtain a staffing balance in the Division. Promotions for the younger scientists had become almost impossible. The younger Ph.D's that we hired were GS-11's and 12's; thus, if they were good scientists, they were ready for promotion in two or three years. However, these critical promotions were very scarce; this damaged the Division's morale and we lost some of our outstanding young scientists. Finally, the amount of bookkeeping, specifically the increasing number of WUAS's that had to be completed, reduced the productivity of every scientist. It was our intent to try and reduce this bookkeeping trend. However, the Congressional Budget and Impoundment Control Act of 1974 had required a change in the timing of the fiscal year. This change became effective at the start of fiscal year 1977, which began 1 October 1976, and ended 30 September 1977. Fiscal year 1976 began 1 July 1975 and ended 30 June 1976. Then there was a three-month transitional period beginning 1 July 1976 and ending 30 September 1976; this period was designated FY 19TQ (transitional quarter). Well! We had met and overcome these problems before and could see no reason why we could not continue to do so in the future.

In fiscal year 1977 the Chemistry Division's staff consisted of 104 full-time employees and approximately 50 "other" personnel ("other" personnel included National Research Council Research Associates, part-time employees, sabbatical research visitors, and contract employees). The quality of the Division's staff was recognized by many awards and by election of Division personnel to offices in professional societies. The Division's financial support ($8.4M) came from more than ten sources (i.e., ONR, NAIR, NELEX, NSEA, CNM, Other DoD, Non-DoD, and Other Navy funds). This support was distributed throughout the various DoD research categories (6.1 research, 6.2 exploratory development, 6.3 advanced development, and others).

The Division's research activities were of considerable importance to the Navy, to DoD, and to the Nation. For example, mass spectrometry research in the Chemical Diagnostics Branch led to the development of the CAMS atmosphere analyzer which is being installed on all U. S. Navy nuclear submarines. This group characterized the nuclear submarine's atmosphere. Basic research in synthetic chemistry in the Polymeric Materials Branch produced a highly fluorinated urethane coating which was tested in the bilges of the USS FORRESTAL (CV 59) and on the hull of the USS SAND LANCE (SSN 660). Electrochemistry research in the Inorganic and Electrochemistry Branch had increased our understanding of battery failures. The Surface Chemistry Branch's research in tribology and Surface characterization

research led to new aircraft lubricants, and more reliable operation of the Polaris and Poseidon missile systems. Finally, the Combustion and Fuels Branch served as the Navy's fireman and fuel strategist. In addition, current research in this Branch promised to produce a low-temperature, low-pressure route to liquefaction of coal.

In 1979, Dr. W. B. Fox, Head, Inorganic and Electrochemistry Branch, Code 6130, was assigned on detail for 20 months as a senior technical manager and scientist for the Assistant Director for Research, Office of the Deputy Under Secretary of Defense for Research and Advanced Technology.

Drs. Homer Carhart and Joseph Leonard, Combustion and Fuels Branch, led a VERY large NAVSEASYSCOM program on ship fire protection and damage control. Therefore, in 1979, Dr. Saalfeld recognizing a need for an NRL focal point in this NAVSEASYSCOM program requested Directorate approval for establishment of the Program Office on Fire Protection and Damage Control, Code 6104. Approval was granted and Dr. Carhart was named Head of the Project Office, Dr. Joseph Leonard was named Deputy and Ms. Evelyn Childs was named Staff Assistant. The Program Office was responsible for coordination, administration, contracts and planning support for Fire Protection and Damage Control.

September, 1979, after 36 years of service at NRL, Dr. L. B. Lockhart, Jr., retired from his positions as the Head of the Polymeric Materials Branch, Code 6120, and the Division Associate Superintendent. Upon his retirement, Dr. Lockhart was awarded the Navy Superior Civilian Service Award in recognition of his scientific and administrative contributions as the Head of the Polymeric Materials Branch and for his leadership as the principal investigator of the V/STOL and Electroactive Polymer Programs.

In December, 1979, Dr. Saalfeld was assigned temporary duty as Chief Scientist and Scientific Director, Office of Naval Research, London. During this assignment, Dr. L. B. Lockhart, Jr., returned as a "re-employed annuitant" and was designated Acting Superintendent.

Following Dr. Saalfeld's reassignment to NRL in 1980, Dr. Lockhart again retired from the Division with sincere appreciation of the entire Staff!

Upon Dr. W. B. Fox's return to NRL in 1981, he was reassigned from Head of the Inorganic and Electrochemistry Branch, Code 6130, to Head of the Polymeric Materials Branch, Code 6120. Dr. D. L. Venezky was selected to Head the Inorganic and Electrochemistry Branch, Code 6130. Dr. Venezky had been the Head of the Solution Chemistry Section, Inorganic and Electrochemistry Branch, Chemistry Division, and had been Acting Branch Head for a portion of the time Dr. Fox was on

reassignment. His research interests are in the areas of solution chemistry and the reactions of substances in aqueous solutions at high temperatures and pressures. Recently, he developed a new surface cleaning formulation that employs a unique approach to removing contamination prior to applying protective coatings. Also during 1981, Dr. Venezky was appointed additional duties as the Associate Superintendent of the Division.

During July, 1981, after twelve years as the Head of the Surface Chemistry Branch, Dr. N. L. Jarvis requested reassignment from his position. Dr. Jarvis stipulated that, "this reassignment would provide me an opportunity to improve my research skills and knowledge and become more actively engaged in areas of research of considerable importance to the Navy." He stated that he was, "leaving the Branch in excellent condition - well staffed, very productive and with strong leadership at the Section Head Level." The reassignment was granted and Dr. Jarvis became the Head of the Graphite and Carbon Fiber Research Section, Surface Chemistry Branch. His replacement as Branch Head was Dr. J. S. Murday. Dr. Murday as Head of the Chemical Defense and Countermeasures Material Section, Surface Chemistry Branch, was a proven talented and knowledgeable physicist with demonstrated Section Head leadership. Dr. Murday built the NRL Surface Analysis Program from zero to one of the best recognized efforts in the world. He also developed and maintains an innovative basic research program in carbon chemistry.

PERSONNEL, MISSION AND RESEARCH FACILITIES - 1981/82 (7)

The Chemistry Division staff in October, 1981 consisted of 108 full-time employees and approximately 91 "other" personnel. Fiscal Year 1982 has started with 115 full time personnel and 132 "other" employees. The quality of the Division's staff had been recognized by many awards and by election of Division personnel to offices in professional societies; these recognitions are cited in Appendix K. The Division's FY 1982 Organizational Staff and a glimpse at the Division's research programs are shown in Appendix L.

The Chemistry Division was now equipped with an exceptional array of modern chemical equipment. The world of the chemist is no longer the world of test tubes, beakers, retorts, and one person watching a distillation. The modern chemist today makes use of such instrumentation as computers, lasers, infrared spectrometers including a Fourier Transform IR Spectrometer, Raman Spectrometers, Nuclear Magnetic Resonance Spectrometers (NMR), mass spectrometers, X-ray diffraction spectrometers, atomic absorption spectrometers, Auger Spectrometers, X-ray photoelectron spectrometers, XPS chromatography and other modern tools. The impact of computers cannot be overestimated -- computers extended the capability of well-established diagnostic techniques such as gas chromatographs (gs), mass spectrometers (ms), and combination gc/ms. The use of computers for (1) the

newly established Theoretical Chemistry Section, Code 6130, was essential and (2) for signal averaging and data processing they have revolutionized chemical kinetics studies and Carbon 13 NMR, opening new vistas for chemists. The Division also has a unique fire research facility which includes highly instrumented reactors of various sizes and designs coupled to microprocessors, a 30x30x30 ft controlled ventilation facility for studying fires and smoke, and pressure chambers ranging in size up to 10,000 cu. ft. (named Fire I) for studying fires in confined spaces and with controlled atmospheres. The Division maintains a fire research facility at NRL's Chesapeake Bay Detachment in Calvert County, Maryland, for the study of large open fires up to 100 ft in diameter, and their extinguishment.

In Fiscal Year 1981 the Chemistry Division's financial support ($12M) came from multiple sources and was distributed throughout the various DoD research categories (6.1 research, 6.2 exploratory development, 6.3 advanced development, and other) as shown in Appendix M. (In Fiscal Year 1982 the Division's financial support reached $16M.)

The Division's research activities were organized into three major thrusts: MATERIALS, DYNAMICS, and DIAGNOSTICS. These are of considerable importance to the Navy, to DoD, and to the Nation. For example, mass spectrometry research in the Chemical Diagnostics Branch led to the development of the submarine atmosphere control system that continues to be installed on all U. S. Navy nuclear submarines. Research in synthetic chemistry in the Polymeric Materials Branch produced a fuel tank lining coating which is used at Naval Bases around the world. High Temperature Chemistry research in the Inorganic and Electrochemistry Branch has increased our understanding of marine turbine blade failures. The Surface Chemistry Branch's research in tribology and surface characterization research led to new aircraft lubricants, and to more reliable operation of the Polaris and Poseidon missile systems. Finally, the Combustion and Fuels Branch developed the novel, elegant nitrogen pressurization approach for the suppression of submarine fires.

With the array of modern equipment available to the Chemistry Division's outstanding staff, exceptional productivity is expected. It is, therefore, not surprising that the Chemistry Division has contributed to the solution of many Fleet, National, and scientific problems in the past. Some of the Division's significant accomplishments (1960 - 1982) are listed in Appendix H-2 (there is an obvious overlap in this chronological continuation with that of Appendix H-1, however, change in management does wonderous things).

FIFTY-FIFTH YEAR OF THE DIVISION HISTORY

When 1982 commenced, the only thing I was really sure of was the fact that I would retire. Well, in retrospect, that soon became a very minor occurrence as I witnessed those continuing major changes in personnel.

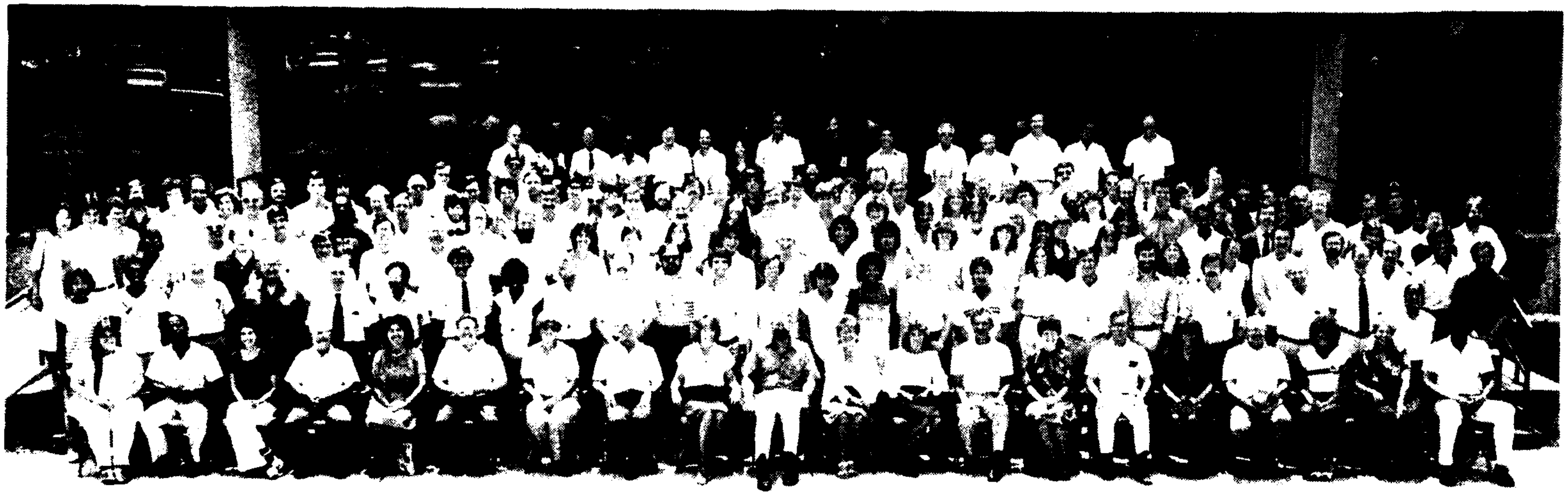
In July, 1982, Dr. Alan Berman, Director of Research, resigned from the Laboratory and Dr. A. I. Schindler our Associate Director of Research (Code 6000) was selected to be Acting Director until this vacancy was filled. Then, Dr. Saalfeld was appointed Acting Associate Director of Research for the Materials Science and Component Technology Directorate (Code 6000) (still maintaining his position as Superintendent of Chemistry).

The real surprise occurred in October, 1982, when Dr. Saalfeld accepted a position as Director of Research Programs (Code 400) at the Office of Naval Research, Washington, D. C. He was transferred effective 1 November 1982. Dr. Saalfeld wrote in a Chemistry Division Newsletter, "The Chemistry Division is one of the most outstanding chemistry institutions in the country. I want to thank everyone in the Division for their outstanding efforts in helping me build a reputation that enabled me to attract such an offer. I will have always a very warm spot in my heart for the Division. After having spent 20 years in the Division, leaving it is not a step I take lightly, but the opportunity to be in charge of the entire Navy 6.1 contract research program and be a member of the ONR corporate board was too good an opportunity to bypass."

Dr. H. W. Carhart, Head of the Combustion and Fuels Branch and an employee of the Chemistry Division for 40 years (the only one of the original Branch Heads to survive my tenure) was appointed as Acting Superintendent of the Division. Dr. Carhart is a truly recognized leader throughout the world in combustion and fuels. His fundamental and applied research efforts in combustion have led to safer ships with more efficient propulsion systems; his innovative concepts in developing nitrogen pressurization offer the opportunity to have non-toxic fire extinguishing agents aboard Navy submarines; and he has received numerous awards for his outstanding contributions to the solution of some of the Navy's most critical problems. Dr. Carhart would be most capably assisted by Dr. D. L. Venezky, our veteran Associate Superintendent.

Appendix I-2 represents the Division's staff changes from 1970 through 1982 (this is a chronological continuation of Appendix I).

Over 55 years, the Chemistry Division has grown from a small and dedicated group of scientists to one of the leading scientific Laboratories in the world (Figure 9 shows some of the current 275 Division personnel, while Figures 10, 11, and 12,



Chemistry Division

1982

Fig. 9 — Picture of *some* of the division employees during July, 1982.

First Row

1. Jean Smathers
2. Steve Tate
3. Joan Benedict
4. Bobby Clark
5. Beverly Disque
6. Al Harvey
7. Angie Allison
8. Homer Carhart
9. Gail Flaherty
10. Fred Saalfeld
11. Bettye Gibbs
12. Brenda Russell
13. Dave Venezky
14. Cheri Poppino
15. Jim Murday
16. Yvonne McClure
17. Jim Griffith
18. MaryJo Tyrrell
19. Evelyn Childs
20. Hal Eaton

Second Row

1. Sandra Chern
2. Charlie Williams
3. Stan Gadomski
4. Jack Bitner
5. Bill Moniz
6. Ming Chang Lin
7. Teddy Keller
8. Brenda Holmes
9. Norman Li
10. Dennis Hardy
11. Charlie Sink
12. Jeff Hinkley
13. Mike Simmons
14. Carolyn Kaplan
15. Pat Tatem
16. Bob Hazlett
17. Brant Edwards
18. Barbara Berrie
19. Tom Digiuseppe
20. Mike Berman
21. Chuck Dulcey
22. Bob Fox
23. Bob Brady
24. Elaine Shafrin
25. Art Snow

Third Row

1. Kevin Osborne
2. Millie Thompson
3. Chris Rall
4. Scott Wolff
5. Henry Resing
6. Dave Weber
7. Susan Rose
8. Pat Etienne
9. Dawn Dominguez
10. Ed Barbano
11. Mia Bernett
12. Steve Lustig
13. Tina White
14. Susan Brandow
15. Alic McCarter
16. Christina Blust
17. Suzanne Smidt
18. Louise Paternack
19. Joe Campana
20. Hank Wohltjen
21. Rich Colton
22. Greg Burks

Fourth Row

1. Cheryl Roberts
2. Marge Wechter
3. David Duckworth
4. Art Watterson
5. Douglas Lowe
6. Larry Mattix
7. Oh-Kil Kim
8. Al Garroway
9. Fred Williams
10. Ron De Marco
11. Ted Walton
12. Roseanna Felabella
13. Gerry Chingas
14. Bob Neilon
15. Janet McVicker
16. Seeda Pande
17. Kurt Stern
18. Lisa Polyak
19. Jackie Valliant
20. Cheryl Joyal
21. Leslie Polka
22. Pete Mah
23. Jim Holtzclaw
24. Russ Jefferies
25. Maria Barnes
26. Roderick Durham

Fifth Row

1. Ron Sheinson
2. Carole Komenda
3. Chet Poranksi
4. David Farrar
5. Dale Pace
6. A. D. Britt
7. David Shykind
8. Ioannis Sispsas
9. Forrest Carter
10. Dale Peebles
11. Bob Landolt
12. Brett Dunlap
13. Craig Litz
14. Mike Maday
15. Lindy Bast
16. Jeff Calvert
17. Ramanathan Panayappan
18. Debra Rolison
19. Charles Douglass
20. Mike Harmon
21. Carol Delozier
22. Mark Ross
23. Marc Beebe
24. Steve Lloyd

Sixth Row

1. Paul Peyser
2. John Eyler
3. Steve Snyder
4. Donald Field
5. Tom Barlak
6. Noel Turner
7. Bob Doyle
8. David Ramaker
9. Steven Cooper
10. Jeff Wyatt
11. Debbie Porterfield
12. John Mintmire
13. John Anderson
14. Clarence Whitehurst
15. Susan Brandow
16. Paul Lund
17. Dave Tevault
18. Merle Umstead
19. Tom Kovacina
20. George Chamberlain
21. Douglas Nordman
22. Robert Nowak
23. Terrence Barrett
24. Mark Beymer
25. Graham Cheek
26. Jim Fleming
27. David Kidwell
28. Tony Surak

Seventh Row

1. Jack Burnett
2. Carol Brown
3. Victor Deitz
4. Joe Lakshmanan
5. David Hsu
6. Joe Keiser
7. Sharon Selwyn
8. Gary Selwyn
9. Andy Baronavski
10. Tony Nesky
11. Will Affens
12. Harold Ravner
13. Bill Sanders
14. Mike Kaufman
15. Cliff Hand

Fig. 9 (Cont'd) — Chemistry division picture (from left to right)

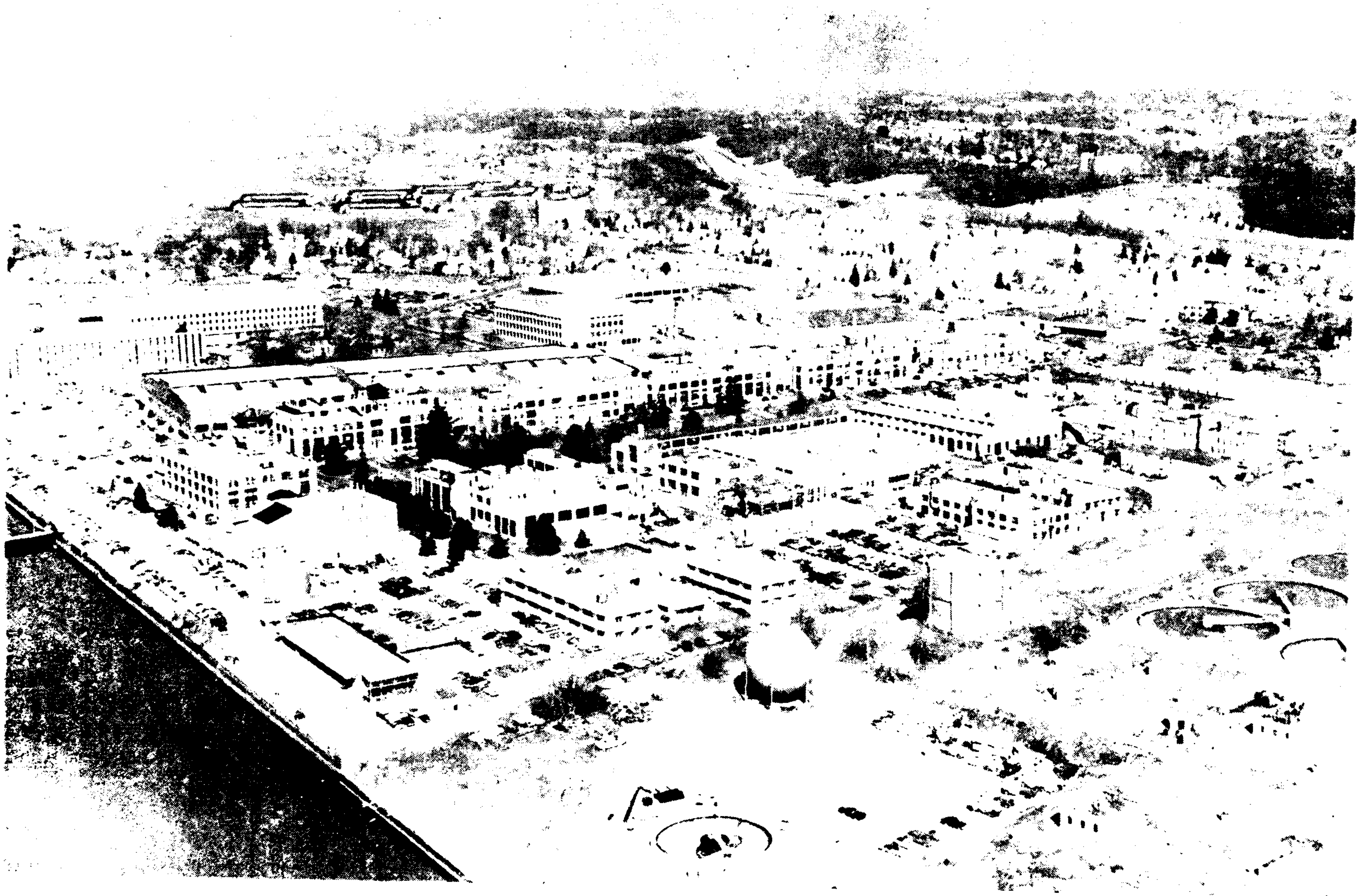


Fig. 10 — Picture of NRL in 1981.

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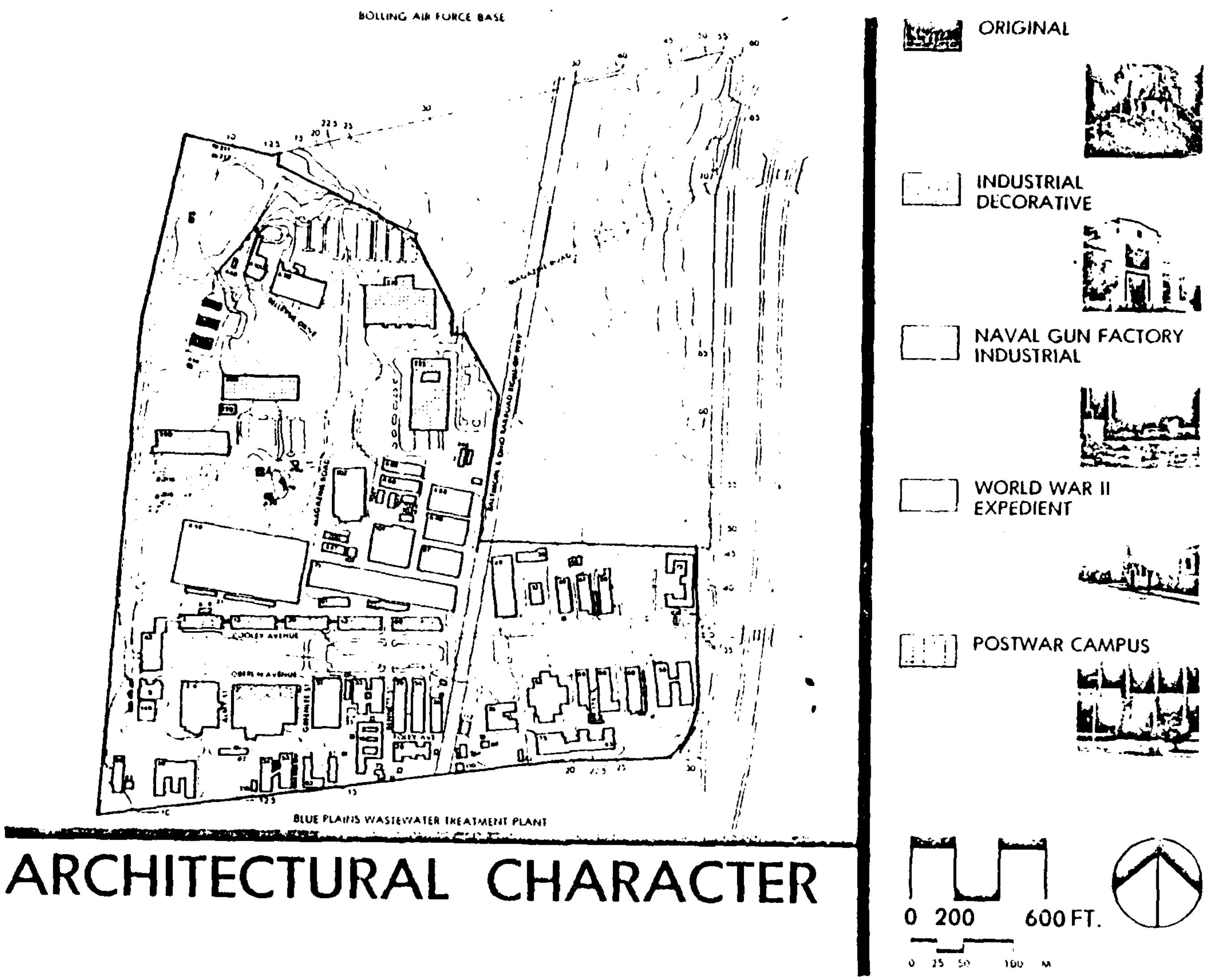

Fig. 11 — Architectural character of NRL, 1981.

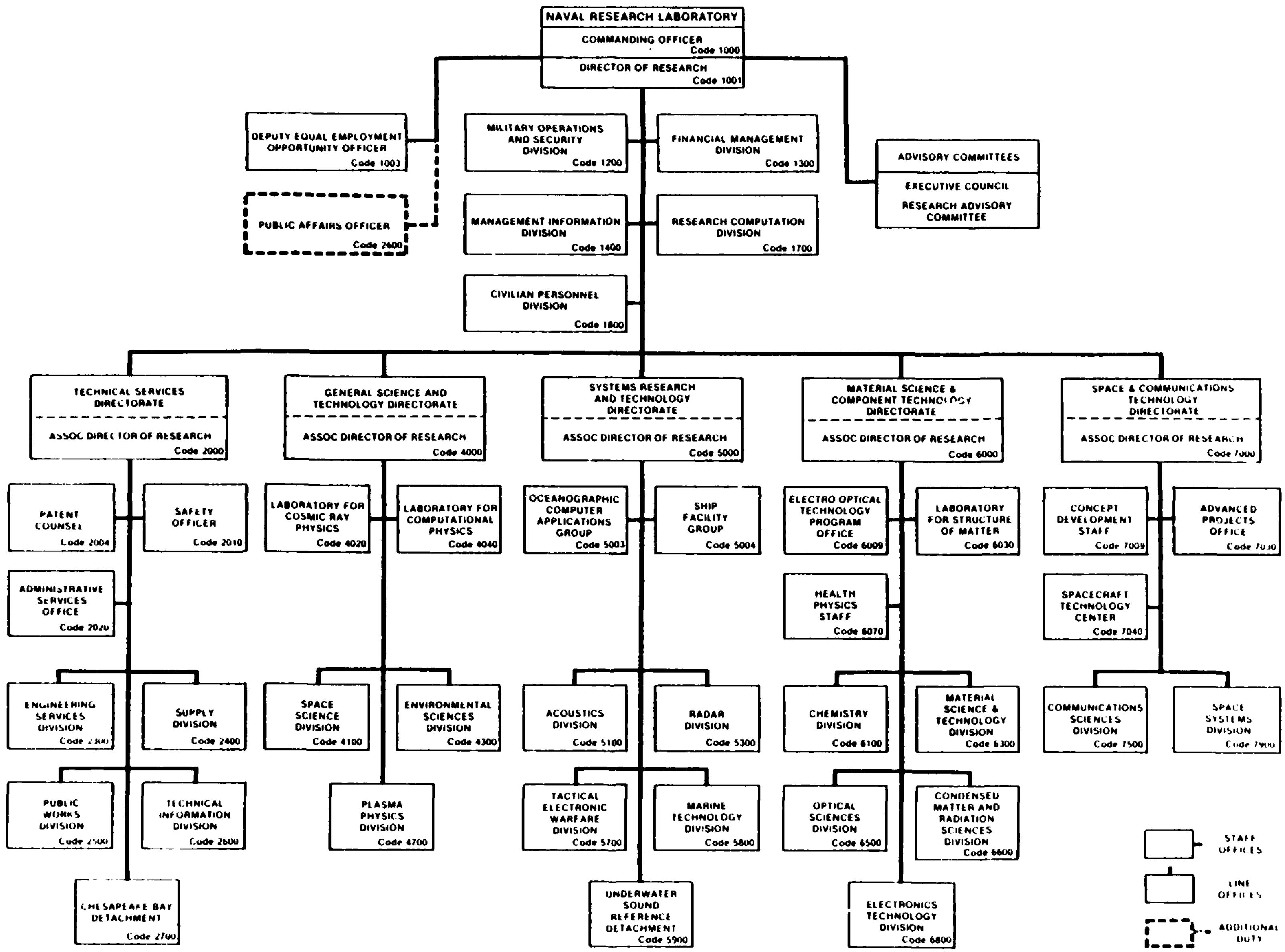

Fig. 12 — Corporate structure of NRL, 1981.

portray the current NRL pictorial, architectural and corporate structure)!

Throughout this history, the Division personnel have continuously carried on high-level research in all areas of chemical science of interest to the Navy. The Division accomplishments confirm the fact that we not only perform basic research leading to future Naval materials and systems, but also serve the Material Commands and the Fleet in aspects of development and Naval warfare, a role for which we are particularly fitted. Thus the Division provides a central focus of research and development activity that supports both the Navy, the National Defense effort and the public sector - simultaneously providing knowledge for the betterment of mankind!

This Division has thought not only of the Navy of our time, but also of a Navy of the future Remember - THE FUTURE IS IN ACHIEVEMENT; IT IS NOT A GIFT!

REFERENCES

The following references contain particulars of some works which may be consulted for further details. Simple acquisition of additional information is obtainable by contacting the Superintendent's secretary. General works of reference are not included.

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2. "The Alexandrian" Magazine, Navy History, 1976.

3. "The First 25 Years of the Naval Research Laboratory" by A. Hoyt Taylor published in 1948.

4. Report on, "Present Status of the Chemistry Division Effort, Naval Research Laboratory," authored by Dr. W. A. Zisman, 27 27 October 1966.

5. "Chemistry Division Program Review" by Dr. W. A. Zisman, approximately 1966.

6. "Chemistry Division Annual Reviews" for 1970 and 1971, authored by Dr. R. E. Kagarise.

7. "Research in the Chemistry Division, 1977 and 1978" and "Key Personnel, Mission and Research Facilities of the Chemistry Division, 1981 and 1982;" all four reports were authored by Dr. F. E. Saalfeld.

FIGURES

APPENDICES

APPENDICES A - F
DIVISION SUPERINTENDENTS
1927 - 1982

Resume A - Dr. F. E. Bichowsky
Resume B - Dr. P. Borgstrom
Resume C - Dr. P. King
Resume D - Dr. W. A. Zisman
Resume E - Dr. R. E. Kagarise
Resume F - Dr. F. E. Saalfeld

APPENDIX A

Resume of
DR. F. RUSSELL (VON) BICHOWSKY

Dr. F. Russell (von) Bichowsky received an A.B. from Pomona College in 1912; an M.S. from the University of California in 1914 and a Ph.D. in Chemistry in 1916. At this time he became a physical chemist in the geophysical laboratory of the Carnegie Institution. He was a national research fellow in chemistry at the Berkeley University from 1919 to 1923 and lectured in mechanical engineering at the University of California. In 1924 he was Editor of the Thermochemistry International Critical Tables. Dr. Bichowsky was regarded as an eminent consultant with major manufacturing concerns. He was the founder and originator of one form of air conditioning. Dr. Bichowsky was the first Superintendent of the Chemistry Division from 1927 through 1933. His career after leaving the Laboratory was as a consulting chemist and inventor up to the beginning of World War II. In 1936, he coauthored, "Thermochemistry of Chemical Substances," with Rossini and in 1942 he published, "Industrial Research." He was an authority on thermodynamics and electrodynamics and during World War II as a scientific analyst with the U.S. Air Corps, he was a scientific observer at the first Bikini atom bomb tests. He was awarded the Medal of Freedom by the War Department for heroic service overseas. As a physical chemist he had worked in a consulting capacity with most of the major concerns in refrigeration, holding several important inventions/patents on processes. He returned to the University of California as a lecturer in 1946. Dr. Bichowsky wrote poetry and books, painted, and was an avid member of the Sierra Club. In San Francisco, April 1951, Dr. Bichowsky died of injuries received in an automobile accident near Baltimore the previous year.

APPENDIX B

Resume of
DR. PARRY BORGSTROM

Following Dr. Bichowsky's resignation, Dr. Parry Borgstrom became the Division's second Superintendent. Dr. Borgstrom studied at Whitman College and at the University of California, taking a Ph.D. from the latter in 1919. He began his career as an instructor at the University of Nevada and later became a research associate at the Massachusetts Institute of Technology, then associate professor and finally research associate for the American Petroleum Institute at Johns Hopkins University. Dr. Borgstrom joined the NRL Chemistry Division staff as an Associate Chemist in January 1929 and was named Division Superintendent in 1934. His exceptional interest in his work and outstanding abilities of leadership paved the way to his receipt of the Distinguished Civilian Service Award in 1946. A portion of the citation read: "His ever present concern for the safety of our fighting men was exemplified in such developments as new chemicals for the Rebreather Gas Mask, aids to personnel downed at sea, and improved methods of fighting oil fires. His far reaching and thorough work in preparing the Navy for chemical warfare, should it be launched, resulted in many important new developments including protective equipment for fighting personnel." Dr. Borgstom retired in 1954 and died in 1961.

APPENDIX C

Resume of
DR. PETER KING

Following the retirement of Dr. Parry Borgstrom in 1954, Dr. Peter King became the third Superintendent of the Chemistry Division. Dr. King began his Government career at NRL in 1939 as a chemist, became a Branch Head in 1949, Superintendent of the Chemistry Division in 1954, Associate Director of Research for Materials in 1956, served as Chief Scientist of the ONR Branch Office, London, from 1964 to 1966, and in 1966 was appointed to the post of Deputy and Chief Scienist, ONR, Washington; he retired from this position in 1972. Dr. King attended both the University of Notre Dame and the University of California at Los Angeles, receiving his BA from the latter institution in 1936. He received his Ph.D. degree in chemistry from the Catholic University of America in 1942. In 1960 he was awarded the Distinguished Civilian Service Award for developing a technique that led to the detection of the first atomic bomb exploded by a foreign power. Dr. King was the Navy representative to the National Research Council. He was the author and co-author of numerous technical papers and had several patents. Dr. King closed his distinguished 33 year career with the Navy Department by receiving the Civilian Career Achievement Award from the Secretary of the Navy for his outstanding contributions to naval research.

APPENDIX D

Resume of
DR. WILLIAM A. ZISMAN

Dr. William A. Zisman, became the fourth Superintendent of the Division in 1956 when Dr. Peter King was appointed as Associate Director of Research for Materials. Dr. Zisman is an internationally acclaimed figure in the field of chemistry. He received his BS degree in Physics from Massachusetts Institute of Technology (1927), an MS degree in Physics from MIT (1928), and a Ph.D. degree in Physics from Harvard University (1932). Dr. Zisman was Head of the Surface Chemistry Branch (formerly Lubrication Branch) for fourteen years and served as Superintendent of the Chemistry Division from 1956 to 1968, when he was named Chief Scientist of the Laboratory for Chemical Physics. A Chair of Science for Chemical Physics was created for him in 1969; he retired from NRL in 1975. Dr. Zisman received the Navy's Distinguished Civilian Service Award, Department of Defense Distinguished Civilian Service Award, Hillebrand Award of the Chemical Society of Washington, Union Carbide and Carbon Award of the American Chemical Society (ACS), A. K. Doolittle Award, National Award of the American Society of Lubrication Engineers, Kendall Company Award in Colloid Chemistry of the ACS, Captain Robert Dexter Conrad Award, and the Mattiello Award for Scientific Achievement. A past division chairman of the ACS and past president of the Washington Section of the ACS, Dr. Zisman is a member of the American Physical Society, the Washington Academy of Science, New York Academy of Science, National Society of Lubrication Engineers, Sigma Xi, and a Fellow of the American Society of Lubrication Engineers.

APPENDIX E

Resume of
DR. RONALD E. KAGARISE

In 1968, when Dr. Zisman was appointed Chief Scientist of the Laboratory for Chemical Physics, Dr. Ronald E. Kagarise became the fifth Superintendent of the Chemistry Division. Dr. Kagarise received his B.A. degree from Duke University in 1948 and his M.S. and Ph.D. degrees in Physics from Pennsylvania State in 1949 and 1951, respectively. From 1952 to 1966, he had been employed in the Chemistry Division of the Naval Research Laboratory with the exception of one year with the Office of Naval Research, London. Prior to his appointment as Superintendent, Dr. Kagarise was Program Director for Physical Chemistry at the National Science Foundation. He departed NRL in 1975 to accept an appointment with the National Science Foundation as Division Director for Materials Research. Dr. Kagarise is a member of the American Physical Society, American Chemical Society, Sigma Xi, Washington Academy of Sciences, Coblentz Society, and Sigma Pi Sigma. He has authored numerous works in his field of chemical spectroscopy.

APPENDIX F

Resume of
DR. FRED E. SAALFELD

Dr. F. E. Saalfeld became the sixth Superintendent of the Chemistry Division. He received a B.S. degree cum laude with honors in Chemistry from Southeast Missouri State University, in 1957. His M.S. and Ph.D. degrees were received in Physical Chemistry from Iowa State University in 1959 and 1961. After receiving his Ph.D. degree, Dr. Saalfeld remained at Iowa State for one year of postgraduate studies under Professor H. J. Svec. In 1962, Dr. Saalfeld joined the Naval Research Laboratory where he conducted and directed research in physical chemistry. His research specialty is the application of mass spectrometry to chemical problems such as combustion, lasers, catalysis, etc. Dr. Saalfeld has authored or coauthored more than 400 research papers, reports and talks. From 1963 to 1973 he was the Head of the Mass Spectrometry Section at NRL. From 1974 to 1976, he was the Head of the Physical Chemistry Branch, Chemistry Division. In July, 1976, Dr. Saalfeld was selected as Superintendent of the Chemistry Division. In 1980, he was assigned temporary duty as Chief Scientist and Scientific Director, ONR, London. For his accomplishments during this tour of duty, he was awarded the Navy Meritorious Civilian Service Award. Beginning June, 1982, Dr. Saalfeld was chosen to be Acting Associate Research Director of Material Science and Component Technology, NRL, until the permanent Associate completed his tour as Acting Director of Research and a permanent Director of Research was named for the Laboratory. Dr. Saalfeld is very active in many scientific societies including the Society for Applied Spectroscopy, American Society for Mass Spectrometry, and the American Chemical Society. He served as Secretary of the American Society for Mass Spectrometry for four years (1970-74) and as the President of the Chemical Society of Washington (1972). Dr. Saalfeld transferred, 1 November 1982, from the Naval Research Laboratory to the position of Director Research Programs, Office of Naval Research, Washington, D. C.

APPENDIX G

COPY OF ORIGINAL LETTER WRITTEN BY
DR. F. R. BICHOWSKY

APPENDIX G

UNEDITED COPY

2020 Asilomar Drive
Oakland 11, California

October 2, 1947

Director of Naval Research Laboratory
Washington 20, D. C.

Attention: A. Hoyt Taylor

Dear Taylor:

I wondered if somebody wouldn't soon be getting around to writing a history of the laboratory, and you, certainly, are the one who ought to do it.

I do not have any records covering the early history of the Chemistry and Thermo-Dynamic divisions. What I shall say is based solely on memory, but Mrs. Pope's records will make it possible for you to work up the exact dates of the events I recall.

The real founder, in my opinion, of the Chemistry Division was CPO Hartman. I have forgotten his first name and initials. Hartman was an anlytical chemist and his principal task was to set up an analytical laboratory and perform routine analyses. He also performed two other much appreciated services, namely, the gilding of brass buttons, and, (it was in the time of prohibition), analysis of whiskey and alcohol. Hartman had been a CPO under Commander Oberlin, and once had saved Oberlin's life. He was a salty CPO from a way back but also a very capable analyst and remained with the laboratory as long as his health held out. Either because of his work with alcohol or other reasons he was subject to very serious ulcers.

At this time (early in 1927), Commander Oberlin had managed to interest the Ordnance Bureau in the type of work that the Laboratory was doing and Ordnance assigned, in the spring of 1927, two problems which they had left over from the first war. These two problems were the exothermic torpedo, and the oxygen torpedo. The exothermic project was inherited from some work done by Mr. Kesley of Westinghouse near the end of the first World War. Kesley's idea was to replace compressed air as a source of power by steam, generated in the course of a chemical reaction. The reaction which he suggested was that of fuel such as alcohol or aluminum with solid sodium chlorate which would furnish the oxygen necessary to burn the fuel. This project had

been carried far enough by Westinghouse under the Bureau of Ordnance to show that large amounts of power could be produced in this way but not enough to show anything about the engineering factors involved.

The other process, the oxygen torpedo, had been suggested by various officers in the Newport torpedo factory. The idea was to use instead of compressed air, air which was enriched with oxygen or replaced by pure oxygen if that were found feasible. A torpedo using slightly enriched air had been built. This problem at the time of my coming had been assigned to Mr. Moore. Both the exothermic torpedo and the oxygen torpedo presented very serious problems. However, it was highly desirable that they be solved because of their intrinsic importance, because it was desirable to obtain the enthusiastic support of the Ordnance Bureau, and also because Mr. Wilbur, the Secretary of Navy, was personally interested in the torpedo. Quite correctly, he thought it was the one weapon which had not been developed to its fullest extent.

I joined the Laboratory in August, 1927, (if I remember correctly), and in the first conference after joining, Commander Oberlin explained the situation and it was decided to consolidate Mr. Moore's work, Mr. Hartman's work, and the Chemistry Department under my direction and to undertake both the torpedo projects.

It was immediately apparent that the particular combination of chemicals used by Kesley introduced tremendous and apparently unsolvable difficulties of control so I suggested replacing the solid sodium chlorate with liquid perchloric acid or with some other oxygen carrying liquid such as nitrogen peroxide, hydrogen-peroxide or nitric acid. This would have the advantage of making it unnecessary to mix two highly dangerous materials before combustion and would allow proper control of the combustion process without danger of spontaneous explosion. It, also, had the practical advantage that it would make possible to isolate two separate problems. Once, the design of a "pot" (combustion chamber) capable of resisting the very high temperatures which would be met in both problems, and, two, the problem of storing and supplying the two liquid components perchloric acid and alcohol.

Since the problem of "pot" was the more difficult, and since the solution of the "pot" problem would also carry with it the solution of the oxygen torpedo, it was decided to concentrate activities on that part of the problem under Mr. Moore. Mr. Moore is really responsible for working out the details of the various ingenious "pot" design and the rapid progress made in solving the problem of the oxygen torpedo are largely due to him, at least, in the earlier days.

By about 1930, the first pure oxygen torpedo was run in the test stand and obtained results even better than had been expected.

Sometime before this, Dr. Canfield, who was a physicist then employed by the Metallurgical Department, was transferred to the Thermodynamic Division as this project soon became known. Mr. Moore who had been on loan from the Bureau of Ordnance Division went back to his original duties.

In the meantime, experiments had been underway on a small scale and aimed at replacing the oxygen in the oxygen torpedo with perchloric acid. Sometime around 1929, the internal workings of a rocket had been designed which the thrust was obtained by the combustion of alcohol with the vapor of perchloric acid. This first experiment was a success in that acceleration of 2 G were obtained, but, as might have been anticipated, the reaction was cranky and tended to have minor explosions. However, it was conclusively shown that a great deal of power could be obtained from the combination if only it could be controlled. Furthermore, the use of organic perchlorates seemed to offer the possibilities of developing explosives of unheard power. For this reason it was decided to enlarge the division adding to it a top high grade organic chemist. Dr. Parry Borgstrom was chosen and joined the Laboratory in 1930, I think. He, however, never did work on the mechanism of the perchlorate reaction, the most important of which was the explosion of which I will speak later.

In the meantime, the Division had grown considerably. The first to be added, as I remember, was Mr. Yerka who came about 1928, drawn from the grab-bag of Civil Service lists and used for sorts of routine chemical tests. The next to join the Laboratory was Dr. Edward Lunn.

When I came to the Laboratory, I made informally among other conditions that one-third of the time and money of the Division be devoted to publishable research of the so-called "pure" type, feeling that the ability of the Laboratory to attract good young men just out of college would depend on the scientific reputation that the Laboratory had established. Therefore, I looked around for the one man in the country whom I thought could never be tempted away from pure science and would thus form the nucleus for division of pure research. I chose Dr. Edward Lunn, son of the famous mathematical physicist, Dr. Lunn of the University of Chicago. Young "Eddie" was a distinguished worker in the field of electronics in the University of California. Together, Dr. Lunn and I started a reasearch on the mechanism of chemical reaction in a vacuum tube. This field was chosen, not only because of its direct scientific interest, but because I foresaw the possibility of using in a vacuum tube

other carriers than the electron. Dr. Lunn and I worked in this field until about 1930 when the Laboratory inherited another problem; that of the battery explosion in submarines.

Because I had no one else to put on the project, because something had to be done immediately (a submarine having tied up to the dock) I, apologetically asked Dr. Lunn to help me out. This was a serious mistake. Once Dr. Lunn had got down in the smelly hole of a particularly disreputable pig boat, he was never the same. He was lost to science. Crawling on our hands and knees, Dr. Lunn and I noted that the inside of the ventilating ducts were covered with sulphuric acid spray, and showed indications on the bottom that there had been many minor fires, in the submarine ventilating system, which were cuased as we afterwards proved by small sparks produced when the conducting film of sulphuric acid on the inside of the ducts was broken by the motion of the ship. This led to a study of the ventilating system for submarine batteries, and, so fascinating did this problem become that I was never able to get Dr. Lunn back into pure research.

One incident I remember. We suspected that the ventilation of the individual cells was very irregular, or, some cells being well ventilated and some hardly ventilated at all. The problem was to measure the ventilation in each of the 120 cells. The flow was too slow to be measured with instruments of standard design. Dr. Lunn got the idea of measuring the rate of flow of some chemical mist or smoke in the tubes. The Commanding Officer refused to allow Dr. Lunn to do this experiment on the ground that ammonium chloride smoke which was first suggested might damage the battery. Rebuffed for the minute, Dr. Lunn thought fast and suggested using tobacco smoke as a indicator of air flow. A preliminary investigation for which we had the cordial cooperation of several in the Laboratory proved that Blackstone cigars made the maximum of smoke. So the technique was to get a good smoker and have him on the signal puff in a small puff of smoke into the entrance of the glass tube. Dr. Lunn with a stop watch would measure the time taken for the smoke to travel down the tube and, thus, the rate of battery ventilation. He called for volunteers and the crew responded in a body. Picking out a husky chief electrician mate, he set to work. The mate lasted about twenty batteries. Others, now, were not so enthusiastic about volunteering. Eventually, Dr. Lunn had to invent a chemical cigar smoking machine to furnish the necessary puffs.

This worked with battery explosions and led to two other studies of submarines. One, under the direction of Dr. Borgstrom, concerned substitutes fo sodalime as a purifying agent for aid. Dr. Borgstrom hit on the use of lithium hydroxide and his experiences in connection with this important improvement on submarine safety form quite a story if you can get him to tell

it. The second attack on the submarine problem was the study undertaken to control the production of spray in the storage battery. Dr. Lunn was responsible for this work. In the meantime, it had been suggested by several people that studies be undertaken to seal the storage battery so that no battery ventilation be necessary. Dr. Crockford of the University of North Carolina was employed during the summer on the old contract basis, in which I had to certify that I received him in good repair and returned him for credit in the same.

Following the general policy of doing fundamental scientific work, a cooperative agreement was entered into with Dr. Harned of Yale University to obtain reliable values for the thermodynamic properties of the lead storage cell.

One of the earliest appointees to the Division was Dr. Walter Rosett. Rosett, a graduate chemist and excellent musician, had a strong creative urge and was used in problems which seemed to require invention. It happened that these were mainly minor problems, including secret ink for submarine use, florescent material for ultra-violet signalling, a new construction of a photo-electric cell, and other small and important gadgets. He also started work on anti-fouling paint but his accident terminated that. Dr. Rosett worked with Canfield and me on the development of the hydrogen detecting instrument for submarine use which later became standard. I used him also in many jobs where a skilled laboratory technician was used. Among these jobs was the preparation of ethyl perchlorate. This material was known to be explosive. Every preceding worker with it had been hurt by its explosion, but we felt that by keeping it under water we would be the exception. The purpose of working with ethyl perchlorate was to make a small start at least in the study of organic perchlorate explosives.

We made about 5 cc without trouble and were engaged in measuring its properties. I had 1 cc Walter had the remaining, when, suddely, the 4 cc in Rosett's hand blew up, and followed a few seconds later by the explosion of the 1 cc in my hand. Rosett's hands were blown to pieces. He lost a thumb and two fingers on one hand and three fingers and a part of the fourth on the other hand. I had had time to lower my hand and the explosion lacerated a palm of the right hand and one leg. Seeing how badly Rosett was damaged, I opened the door, ran to the infirmary and called Captain Oberlin.

Of course, the shock was terrific to Rosett and we had to give him morphia and tourniquet both arms. Captain Oberlin telephoned Providence Hospital and I heard one side of the conversation: Captain Oberlin: "We have an emergency case we're sending you right away" - - - "Hell no, we won't send them to the Navy Yard" - - - "Dam it, I tell you these men have their hands blown up and are coming over right now." All of this

apparently spoken to the Sister Superior, but Oberlin was like this.

This accident officially stopped work on organic explosives but later Dr. Lunn and I secretly repeated the experiment without explosion and found perchlorate was relatively easy to handle if kept under slightly alkaline water rather than pure.

During the period that I was in the Laboratory, there was never any difficulty in the relationships of the Division and the Navy. We were cordially supported by the Bureau of Ordnance in our major project, torpedoes, and by the Bureau of Engineering and C & R in our work on submarines. We also had the support of medicine and surgery in this work. We had no difficulty in obtaining the support of the various directors of the Laboratory. Even during the difficult period when we have five different directors in one year. Part of this is due to the conscientious attempt of all laboratory personnel to make an extra curricular study of Navy organization and habits.

For several years we had regular informal monthly meetings of discussions of problems of Naval history and organization. These meetings were attended both by civilian personnel and selected officers stationed both at the Laboratory and outside. Papers given in these meetings were carefully collected by Dr. Lunn and formed the body of the notorious book, "IS THE NAVY READY."

About this time (1934), I decided to leave the Laboratory and build up my consulting practice and go into industrial work. Of course, I would not have done this if I could have foreseen the threat of war so soon.

This was the period when the Laboratory fortunes were thought to be at slow ebb. Another reason for leaving the Laboratory was the feeling that I could help the work more from the outside than from within.

My resignation from the Laboratory, in 1934, made possible the publication of the collected critical studies already mentioned. It also made possible for me to establish a small lobby on Capitol Hill - a lobby which was responsible in part for the appropriation of $50,000 earmarked "Research." From this appropriation came the funds for the first large program for radar development. Any history of the Laboratory should mention the very important part played by our friends on Capitol Hill, especially Governor Scrugham.

In connection with high frequency radio, the Chemistry Division made one considerable contribution in the discovery that polystyrene had exceptionally low dielectric loss, thus making possible the construction of high frequency sets without

using the glass or porcelain insulators previously thought necessary. There were numerous other cooperative activities of the Chemistry Division with other divisions of the Laboratory which I have not listed. I cannot neglect one service which the Laboratory performed, namely, the establishment of a very extensive stock room, stocking almost every known stable chemical. The genial Irish stockkeeper, I have forgotten his name - - was well known to everyone in the Laboratory.

Now, as to the post-laboratory career of the various personnel. Dr. Lunn left the Laboratory sometime after I did and became head of the Physical Chemical Laboratory of the Bureau of Engraving and Printing. Just before World War II, he died during a meeting of the Chemical Society at Buffalo.

I have not kept in as close touch with Rosett as I should. He has remarried and is living in Brooklyn, but I do not know what he is doing. Canfield and Borgstrom can speak for themselves.

My career, after leaving the Laboratory, has been a consulting chemist and inventor up to the beginning of the war. Then I joined the Army Air Force as Operation Analyst, and saw service in the European Theatre with the 9th Air Force. I was wounded slightly and was awarded for my work.

After the war, I continued with the Air Force for a while, and then re-established my connections with the Navy as operation analyst in Bikini where I was a member of Admiral Blandy's staff.

In 1946, I decided to go back to teaching and now, am a Lecturer in the Department of Engineering at the University of California at Berkeley.

I hope this informal account will serve your purposes. I have had to do it rather hurriedly. It comes to you just as I dictated it and there are probably omissions and mistakes. We have not been able to get it typed.

If there are any specific questions which I can answer do not hesitate to ask me.

Very best regards to yourself and your family. I hope to come back to Washington some time next year and take time to talk things over.

Very sincerely yours,

/s/ Russell Bichowsky

APPENDICES OF
SIGNIFICANT RESEARCH ACCOMPLISHMENTS
CHEMISTRY DIVISION

Appendix H - 1930 - 1949
Appendix H-1 - 1950 - 1969
Appendix H-2 - 1960 - 1981

APPENDIX H

SIGNIFICANT ACCOMPLISHMENTS
CHEMISTRY DIVISION
1930 - 1949

1930 - 32	First introduced the use of X-ray diffraction techniques in the study of battery active material.
1930 - 33	Developed the use of lithium hydroxide for CO_2 elimination on submarines.
1930 - 36	Developed individual cell ventilation for submarine storage batteries - - which eliminated many earlier hazards.
1930 - 37	Made major design and operation changes in submarine storage batteries - - which led to their very dependable performance during World War II.
1931 - 33	Developed and installed first hydrogen detector in submarines with the Physical Metallurgy Division.
1936 -	Initiated the first research and production of potassium superoxide as an oxygen source for rebreathers. These rebreathers were critical to battle damage control operations aboard ships during World War II.
1939 - 43	Invented acoustically transparent antifouling paint - - extending service life of sonar domes for destroyer escorts during World War II.
1940 -	Synthesized several improved CW protective agents and antivesicants.
1940 -	Developed organic linings for fuel storage and distribution tanks. Permitted rehabilitation of old steel and concrete storage tanks providing ready storage with the degree of cleanliness required by the newer fuels.

(Continued - SIGNIFICANT ACCOMPLISHMENTS)

1940 -	Introduced temperature-indicating paints- - useful for remote monitoring of component temperatures. A full line of these paints are now available commercially.
1940 - 41	Developed the hydrogen eliminator used on submarines.
1940 - 41	Developed a method of manufacture of uranium hexafluoride.
1941 - 43	Developed method for preventing hydrogen explosions in closed spaces.
1941 - 44	Developed methods for determination and elimination of stibine (SbH_3) in submarines.
1941 - 45	Designed, constructed, and operated a pilot plant for impregnation of all the ASC carbon (500 tons) used by the Navy in World War II.
1941 - 45	Developed the Navy MK-1 CW agent detector kit.
1941 - 45	Developed activated carbon impregnated CW protective clothing.
1941 - 45	Conducted extensive studies of protective clothing, ointments and gas masks.
1941 - 45	Developed E-3 Smoke Penetration Meter for generation and measurement of aerosols.
1942 -	Originated principles of "tailor-made" lubricants - resulting in synthetic lubricants with double the useful temperature range of petroleum oils.
1942 -	Initiated U.S. development of chlorate oxygen candles used as a breathing oxygen supply, now an emergency oxygen source on nuclear submarines.
1942 - 45	Developed nylon-reinforced self-sealing fuel tanks for aircraft. These tanks used in aircraft during World War II were designed and the prototype manufractured at NRL for the Navy Bureau of Aeronautics.

(Continued - SIGNIFICANT ACCOMPLISHMENTS)

1942 - 45	Played major role in development of the silver-oxide-zinc primary cell.
1943 -	Developed ammonia noisemaker with "white" noise vs. frequency.
1943 -	Expanded research on boron hydrides which led to their use as high energy fuels.
1943 - 46	Originated chemically deposited coatings for reducing (or increasing) the reflection of transparent surfaces - especially adaptable for use in lens systems, instruments, and fighter plane canopies.
1944 -	Developed electrically conducting wicks for use as static dischargers on all commercial and military aircraft (with Electricity Division).
1944 - 45	Designed rubber flutter valves for pulse jet engines - now a standard item on such engines, ram-jet engines, and helicopters (with Mechanics Division).
1944 - 45	Established the principles of open-cell ventilation of submarine batteries - now in widespread use.
1945 -	Produced non-flammable hydraulic fluids - as solution to fire and explosion hazardous operations.
1945 -	Developed vapor phase corrosion inhibitors for the protection of ferrous metals against corrosion during storage and shipment.
1945 - 60	First to publish an extensive compilation of spectral data for the analysis of silicone oils, fluorocarbons, hydrocarbons, rubbers, plastics, and resins.
1945 - 57	Introduced cellulose caprate optical cement for replacement of Canada Balsam - which had become unsatisfactory for optical systems subject to extreme changes in altitude and temperature environment.

(Continued SIGNIFICANT ACCOMPLISHMENTS)

1946 -	Established means for quantitative prediction of rates of corrosion of important metals of construction in tropical environments.
1946 -	Initiated research on properties of liquid alkali metals, particularly on sodium, to determine feasibility of use on USS SEAWOLF.
1946 - 60	Developed radar absorbent materials - for use in camouflage and deception as well as instrumentation, equipment development and test with the Solid State Division.
1948 -	Discovered high temperature antioxidant additives (for lubricants) - permitting the development of currently used high-performance synthetic lubricants for jet and gas turbine engines.
1948 - 50	Identified the compounds, by X-ray diffraction, which constitute the widely used protective phosphate coatings on steel.
1948 - 55	Developed an electrochemical recorder paper of high sensitivity - in limited production for special instrumentation.
1948 - 52	Developed the use of thermal conductivity in gas analysis for hydrogen in the presence of CO_2
1949 -	Originated detection system enabling identification of JOE-1. Initiated collection of atmospheric radioactive contaminants and accomplished first separation of fissionable materials from a Russian bomb permitting identification of the nature of JOE-1.

APPENDIX H-1

SIGNIFICANT ACCOMPLISHMENTS
CHEMISTRY DIVISION
1950 - 1969

1950-	Demonstrated that high-efficiency electrostatic precipitator units were practical for shipboard use (99.9%) efficiency).
1950-56	Development of an atmosphere analyzer system for submarines
1950-60	First made meaningful hydrogen overvoltage measurements on the noble metals - which are so important in the basic understanding of most electrochemical systems.
1950-51	In the Korean War, a team developed special synthetic lubricants for aircraft cannon which had frozen at high altitudes, obtained production from industry, and personally delivered to the combat zone.
1951-	Originated the use of teflon as (storage preservative) a dry lubricant - for storage and service use on armaments. Subsequently, teflon as a protective dry lubricant, solved a host of military equipment storage and reactivation problems.
1951-	Developed a successful theory of mechanical filtration of aerosols incorporating the diffusion, interception, and inertial mechanisms.
1952-	Produced high-efficiency CW/BW aerosol filters - first all-glass filters producible on paper machines - now critical components of many protective systems.
1952-	Improved useful life of high-visibility fluorescent paints by an order of magnitude - to a degree they became economically useful on all planes - for aircraft identification, safety, and launching operations. These paints are now extensively utilized throughout the armed forces, industry, and the civilian economy.

(Continued SIGNIFICANT ACCOMPLISHMENTS)

1952-	Developed the ND-Mark protective mask- standard equipment in the Fleet since 1956.
1953-	Originated antifouling cable preservative - for use at sea - now utilized in mine laying and other mooring operations.
1954-	Produced sub-micron fibers from thermoplastic materials.
1954-56	Developed carbon monoxide burner used in nuclear powered submarines.
1954-56	Established relationship between potential and rate of corrosion of lead and lead alloys in sulfuric acid.
1954-57	Solved the problem of fogging and icing of periscope head windows. This system is now utilized on all submarines.
1956-	Developed a method for determing the particle size distribution of a nonhomogeneous aerosol.
1956-60	Developed new type of leak detector based on thermal conductivity.
1956-58	Identified major sources of contamination of submarine atmospheres - to be hydrocarbons introduced through paints and indiscriminate use of solvents.
1958-60	Determined the nature and amount of aerosols in nuclear submarines - which led to over a tenfold increase in the capacity of the electrostatic precipitators aboard.
1958-61	Developed simple interferometric techniques for dispersion measurments of liquids in the infrared region of the spectrum - the only methods now available for such measurements.
1959-60	Devised procedures for determining noxious impurities in aviators' breathing oxygen - leading to tighter manufacturing standards - yet deflating the psychological fear of aviators about nonexistent toxic contaminants.
1959-64	Developed microscopic techniques for studying active material in batteries - which are now being used throughout the world.

(Continued SIGNIFICANT ACCOMPLISHMENTS)

1960-	Developed aqueous noncontamination (emulsion solvent-free) paints of enhanced gloss for submarine interiors. These paints are the partial answer to control of contamination of submarine atmospheres.
1960-	Discovered cerium oxidation-inhibitors for silicones - permitting the lengthening of the high temperature service life of silicones by a factor of 100.
1960-	Development of new synthetic nonspreading instrument oils - for -65°F service. Solved a whole host of delicate mechanism lubrication problems including gyroscopes, chronometers, fuse mechanisms, miniaturized missile and satellite equipment, etc.
1960-	Developed sensitive (fuel) leak-indicating lacquer for missiles and rockets - which gives colors strikingly different for oxidizers and fuels - thus permitting instant location and identification of the unexpected presence of fuel components.
1960-	Introduced water separometer for (effective) control of surfactant contaminants (levels) in jet fuels.
1960-	Developed a new technique for the visual determination of mustard gas penetration of paint films.
1960-61	Fabricated a rubber insulation liner for solid propellants - used as a base line for all further developments in this field - including Minuteman.
1960-63	Developed sensitive analytical techniques for determining trace impurities in the atmosphere of Mercury capsule- leading to equipment refinement.
1961-	A team located the source of lachrymatory vapors on the USS SNOOK (SS(N)592) - which had postponed acceptance of the submarine by the Navy until after commissioning.
1961-	Invented effective salvage system for smoke and fire-fouled equipment. Discovered principle and applied water and oil displacing liquids for the effective salvage of fuel, smoke or fire-fouled, and sea water flooded military equipment, especially electrical and electronic.

(Continued SIGNIFICANT ACCOMPLISHMENTS)

1961-63 Determined the magnitude of solvent-solute interactions on infrared absorption spectra- resulting in re-evaluation and discarding of previously accepted theories on molecular interactions.

APPENDIX H - 2
SOME SIGNIFICANT ACCOMPLISHMENTS OF THE
CHEMISTRY DIVISION
1960 - 1981

I. MATERIALS

Developed temperature-controlling coatings for space satellite applications.

Established relationships between constitution and adhesion properties of materials.

Determined structure-property relationships for amine-cured epoxy resins used in composite materials.

Developed the basic chemistry leading to successful synthesis of flourinated epoxy and urethane resins.

Established the mechanism of energy transport in organic co-polymer molecules.

Developed a soil-resistant paint based on highly flourinated polyurethane resins.

Developed a dynamic fatigue test which demonstrated the adverse effect of water on the structural reliability of glass fiber composites.

Developed a new class of high temperature resins cross-linked through phthalocyanine groups.

Developed "carbonless fluorocarbon" concept for thermally stable materials and discovered perfluorosulfur-free radicals.

Developed optically clear fluoroepoxy plastics of improved thermal stability.

Successfully transferred technology to industry for synthesis of fluoropolyol and phthalocynine resins.

Discovered a class of polymeric photoconductors based on polyester chains consisting of alternating electron donor and acceptor units.

Successfully synthesized a radiation curable water-resistant resin based on fluorinated esters of acrylic acid.

Discovered method for applying metal coatings to non-conducting substrates.

I. <u>MATERIALS (Cont'd)</u>

Demonstrated that high conductivity graphite fibers can be produced by intercalation.

Developed a new low-cost series of phthalocynanine polymers of improved performance.

Demonstrated fouling-release properties of NRL fluorourethane paints.

Discovered a new method, using polyvinylpyrollidone, for cleaning and protecting steel surfaces prior to coating.

Discovered that ion implantation can be used to increase the electrical conductivity of certain organic polymers.

Demonstrated catalytic effect of metal-organic salts on combustion of carbon fibers.

The ion implantation of polyacetylene causes chemical modification of the polymer rather than destruction of the material. The most important result of this ion implantation is the remarkable increase in stability of the material.

The reactions of sulfur oxides with cobalt oxides were investigated at high temperatures and the results showed that sulfur trioxide is catalytically reduced to sulfur dioxide and that a liquid solution of cobalt (II) and sodium sulfates causes turbine blade corrosion. The significance of these findings is that monitoring the turbine exhaust gas for sulfur trioxide will not insure against a non-corrosive environment on the turbine blade.

First demonstration of nitration of hydrocarbons (related to propellants and explosives) using laser excited nitrogen dioxide as a reagent in both gas and liquid phases.

Developed high temperature oxidation-inhibitors for silicone fluids.

Developed a preservative lubricant for small arms exposed to seawater immersion.

Developed a class of inorganic antioxidants to stabilize advanced jet engine lubricants to temperatures of 370^{o}C.

Developed an all-weather, corrosion-inhibiting lubricant for rapid-firing naval aircraft machine guns.

Demonstrated a chemical system for breaking oil/water emulsions.

I. MATERIALS (Cont'd)

Demonstrated that ion implantation modifies crystal structure of steel alloy surfaces with resultant change in surface properties (e.g., hardness).

Devised general purpose decontaminant/disinfectant ASH/SLASH (Activated Solution of Hypochlorite/Self Limiting ASH).

Demonstrated the use of visible cw laser for nitroadamantane synthesis in the liquid phase.

Radical doping for surface modification of polyacetylene film with NH.

A series of full scall hull insulation fire tests have been accomplished in FIRE I.

II. DYNAMICS

Developed and demonstrated synthetic agent (Aqueous Film Forming Foam, AFFF) for the extinguishment of liquid fuel fires.

Developed microsecond current-pulse techniques to elucidate the kinetics of fundamental electrochemical reactions.

Developed AFFF/dry chemical "twin-agent" fire suppression systems.

Developed a method and apparatus for reducing electrostatic charge generated in flowing hydrocarbon fuels.

Developed EDTA water treatment to minimize corrosion, fouling, and maintenance of ships' boilers.

Revealed mechanism of low-power hot corrosion of marine gas turbine engine blades.

Identified the pro-static effect of water in jet fuel filtration systems.

Developed seawater MnO_2 cathode battery.

Demonstrated that coal can be fragmented into small molecules by an inexpensive, low temperature air oxidation.

Demonstrated that fires in submarines can be extinguished by pressurizing with nitrogen while still maintaining a habitable atmosphere.

II. DYNAMICS (Cont'd)

Developed a pop-up device for use on the flight decks of aircraft carriers to prevent the fire fighting nozzle from clogging and becoming inoperative.

Characterized the chemical and physical properties of JP-5 and DFM from Shale II and established the relationship between the chemical structures and the fuel properties and behavior.

Developed procedures for salvage of fuel, smoke or fire-fouled, and seawater-flooded military equipment, especially electrical and electronic.

Determined the surface chemical properties of sea surfaces, leading to improved understanding of capillary wave damping and surface evaporation.

Developed theory of separation of water from jet fuel passing through a fibrous filter/coalescer.

Demonstrated feasibility of an underground protective shelter, capable of housing 100 persons for two weeks under winter and summer conditions.

Demonstrated feasibility of STOPS (Shipboard Toxicological Operational Protective System).

Demonstrated that hydrogen chloride adsorbed on water and soot aerosols (smoke) possess a significant threat to Navy personnel in fires.

Developed and tested catalyzed combustion model for carbon fibers.

III. DIAGNOSTICS

Developed ultrasensitive analytical techniques for the determination of trace impurities in the atmospheres of submarines and space capsules.

Conducted extensive measurement of fission product atmospheric radioactivity along the 80th meridian (west).

Developed method for quantitative analysis of polyol-based military aircraft turbine lubricants using NMR spectroscopy.

Developed the Total Hydrocarbon Analyzer for nuclear submarines.

III. DIAGNOSTICS (Cont'd)

Discovered several series of new chemical laser reactions.

Demonstrated the effect of vibrational excitation (with lasers) on rates of bimolecular reactions (e.g., $NO + O_3$).

Developed CAMS (Central Atmosphere Monitor System) mass spectrometer analyzer for nuclear submarines and in other Navy applications.

Chemically Induced Dynamic Nuclear Polarization (CIDNP) used to identify transient intermediates in the oxidation of alcohols by hydroperoxides.

Made first measurements of vibrational populations of N_2 in an electrical discharge with CARS (Coherent Anti-Stokes Raman Spectroscopy).

Identified the vapor species produced when $(SN)_x$, and $(SN\ Br_y)_x$ conducting polymers are sublimed.

Developed a sensitive optical monitor for radioactive iodine.

Conducted the first laser-induced saturated fluorescence measurements of radicals in flames.

Determined reaction rate chemistry of C_2 radical, an important species found in flames.

Constructed a unique high performance secondary ion mass spectrometer which can detect ions greater than 5000 atomic mass units, a level five times greater than has been observed previously.

First observation and verification of surface enhanced Raman effect in ultrahigh vacuum: Pyridine physisorbed on sputter-cleaned silver and gold was studied in UHV.

Formulated safety guidelines for shipboard chemical laser systems.

Produced, analyzed and detected mass-resolved ions in excess of mass-to-charge ratio of 18,000, a factor of almost 20 times greater than obtainable with conventional instruments.

Correlation of the non-monotonic ion intensity distribution of cluster ion size with the three dimensional structure of structures of alkali halide cluster ions.

APPENDICES OF
CHRONOLOGICAL STAFF LISTINGS
CHEMISTRY DIVISION

Appendix I - 1942 - 1949
Appendix I-1 - 1950 - 1969
Appendix I-2 - 1970 - 1981

APPENDIX I

CHRONOLOGICAL STAFF LISTINGS OF THE
CHEMISTRY DIVISION
1942 - 1949

July, 1942

Laboratory Director	RAdm H. G. Bowen	Code 200
CHEMISTRY DIVISION		
Superintendent	Dr. P. Borgstrom	Code 450
Paints	Dr. A. L. Alexander	Code 451
Phys.&Inorganic	Mr. R. R. Miller	Code 452
Fuels	Dr. D. Fore, Jr.	Code 453
Electrochemistry	Dr. J. C. White	Code 454
Corrosion	Dr. T. P. May	Code 456
Special Research	Mr. R. Tuve	Code 457
Lubrication	Dr. W. A. Zisman	Code 458
Protective Chem.	Dr. W. C. Lanning	Code 459
Chemistry Stockroom	Mr. J. O'Leary	Code 460

NOTED:
Dr. H. W. Carhart was hired.
Mr. R. R. Miller became Section Head.
Dr. W. A. Zisman became Section Head.
Dr. J. C. White became Section Head.
Dr. D. C. Smith was hired as a contract employee.

July, 1943

Laboratory Director	RAdm. A. H. Van Keuren	
CHEMISTRY DIVISION		
Superintendent	Dr. P. Borgstrom	Bldg. 30
Ass't. Supt.	Mr. S. Gulbrandsen	Bldg. 35
Paints	DR. A. L. Alexander	Bldg. 26
Phys. & Inorg.	Mr. R. R. Miller	Bldg. 35
Fuels	Dr. D. Fore, Jr.	Bldg. 26
Electrochemistry	Dr. J. C. White	Bldg. 26
Corrosion	Dr. T. P. May	Bldg. 35
Special Research	Mr. R. L. Tuve	Bldg. 35
Lubrication	Dr. W. A. Zisman	Bldg. 26
Protective Chemistry	Dr. W. C. Lanning	Bldg. 44
Dielectrics	Dr. M. A. Elliott	Bldg. 26
Stockroom	Mr. J. O'Leary	Bldg. 1

NOTES:
Dr. L. B. Lockhart, Jr., hired as a contract employee.
Mrs. M. A. Presbrey was hired as the <u>first</u> secretary to the Division Superintendent.
Mr. Gulbrandsen appointed Associate Superintendent.
Establishment of the Dielectrics Section.

(Building numbers are shown here as first I could identify them - the code numbers had remained the same)

July, 1945

Laboratory Director	RAdm. A. H. Van Keuren	
CHEMISTRY DIVISION		
Superintendent	Dr. P. Borgstrom	Bldg. 54
Div. Sec'y.	Mrs. M. Presbrey	Bldg. 54
Ass't Supt.	Mr. S. Gulbrandsen	Bldg. 54
Prot. Coatings	Dr. A. L. Alexander	
Phys.& Inorg.	Mr. R. R. Miller	
Fuels	Dr. D. Fore, Jr.	
Electrochemistry	Dr. J. C. White	Bldg. 54
High Polymers	Dr. P. King	Bldg. 54
Corrosion	Dr. T. P. May	
Special Research	Mr. R. Tuve	
Lubrication	Dr. W. A. Zisman	Bldg. 54
Prot. Chem.	Dr. W. C. Lanning	
Dielectrics	Dr. M. A. Elliot	
Spectroscopy	Dr. D. C. Smith	Bldg. 26
Chem. Stockroom	Mr. R. C. Williams	Bldg. 26

NOTES:

Dr. Lockhart was made the Head of the Special Problems Unit, High Polymers Section.

Dr. P. King hired by NRL and appointed Head, High Polymers Section.

Dr. D. C. Smith hired by NRL and appointed Head, Spectroscopy Section.

Dr. W. C. Lanning resigned.

Paints Section was changed to the Protective Coatings Section.

Head of the Chemical Stockroom was changed.

The Superintendent of the Chemistry Division and some of the Sections occupied Bldg. 54.

(Code numbers remained the same - Building numbers indicated above where changed.)

1946

During 1946, the Research Staff (comprised of all the research divisions of the Laboratory) was renamed the Scientific Staff ; all the Research Divisions were renamed Scientific Divisions .

Dr. E. A. Ramskill was selected to Head Protective Chemistry Branch

Dr. C. R. Singleterry was hired as Head, Colloids Section, Lubrication Branch.

Division Branch code numbers were revised to 8XX.

Chemical Stockroom was no longer under the cognizance of the Chemistry Division, but was maintained for labwide usage.

Division title of Assistant Superintendent was changed to Associate Superintendent.

1947

Director	Commodore H. A. Schade
CHEMISTRY DIVISION	
Superintendent	DR. P. Borgstrom
Assoc. Supt.	Mr. S. Gulbrandsen
Adm. Ass't.	Mr. P. O. Blau
Consultant(Dielectrics)	Dr. M. A. Elliott
High Polymers	Dr. P. King
Lubrication	Dr. W. A. Zisman
Protective Chemistry	Dr. E. A. Ramskill
Protective Coatings	Dr. A. L. Alexander
Electrochemistry	DR. J. C. White
Phys. & Inorg.	Mr. R. R. Miller
Corrosion	Dr. T. P. May
Engineering Research	Mr. R. L. Tuve

NOTES:

Mrs. M. A. Presbrey, secretary, resigned in 1947.

Mr. R. O. Blau was hired as the first Research Administrative Aide

Dr. D. Fore, Jr., resigned to go with Phillips Petroleum Co., Bartlesville, Oklahoma

Dr. T. P. May resigned.

Mr. T. D. Callinan was hired to work in the area of dielectrics.

(Codes and building numbers remained the same.)

1948

Laboratory Director	Captain H. S. Schade	Code 1100

CHEMISTRY DIVISION

Superintendent	Dr. P. Borgstrom	Code 3200
Assoc. Supt.	Mr. S. Gulbrandsen	Code 3201
Res.Adm.Asst.	Mr. R. O. Blau	Code 3202
Consultant(Dielectrics)	Dr. M. A. Elliott	Code 3206
High Polymers	Dr. P. King	Code 3210
Prot. Ctgs.	Dr. A. L. Alexander	Code 3220
Phys. & Inorg.	Mr. R. R. Miller	Code 3230
Protective Chem.	Dr. E. A. Ramskill	Code 3240
Eng. Research	Mr. R. L. Tuve	Code 3250
Electrochemistry	Dr. J. C. White	Code 3260
Lubrication	Dr. W. A. Zisman	Code 3270

NOTES:
Dr. M. A. Elliott transferred to the U. S. Navy Mine Countermeasure Station, Panama City, Florida

(April, 1948, in order to obtain a systematic code structure and to eliminate the use of separate organizational unit designators for job order numbers and the code, new code numbers were assigned throughout the Laboratory (note Chemistry code numbers changed from 8XX to 32XX)).

1949

Mr. D. L. Venezky hired as a chemist in the Protective Chemistry Branch
Mr. R. O. Blau separated from the Chemistry Division.
Dr. E. O. Hulburt was appointed as the FIRST Director of Research, Code 3000, location in Bldg. 1.
All Laboratory SECTIONS were renamed BRANCH.

APPENDIX I-1

CHRONOLOGICAL STAFF LISTINGS OF THE CHEMISTRY DIVISION 1950 - 1969

October, 1950

Laboratory Director	Captain F. R. Furth
Director of Research	Dr. E. O. Hulburt

CHEMISTRY DIVISION

Superintendent	Dr. P. Borgstrom	Code 3200
Assoc. Supt.	Mr. S. Gulbrandsen	Code 3201
Sci.Staff Asst.	Mr. V. R. Piatt	Code 3202
Consultant	Mr. T. D. Callinan	Code 3206
High Polymers	Dr. P. King	Code 3210
Protective Coatings	Dr. A. L. Alexander	Code 3220
Phys. & Inorganic	Mr. R. R. Miller	Code 3230
Protective Chemistry	Dr. E. A. Ramskill	Code 3240
Engineering Research	Mr. R. L. Tuve	Code 3250
Electrochemistry	Dr. J. C. White	Code 3260
Lubrication	Dr. W. A. Zisman	Code 3270

NOTES:

Mr. T. D. Callinan replaced Dr. M. A. Elliott as a Consultant in Dielectrics.

Mr. V. R. Piatt was transferred from the Personnel Division to Chemistry Division.

1951

Dr. D. C. Smith resigned to accept a position with Phillips Petroleum Co., Bartlesville, Oklahoma.

1952

Dr. R. E. Kagarise was hired as the Head of the Spectroscopy Section, Code 3210.
The Fuels Branch, Code 3280, was established and Dr. Homer W. Carhart was named as its Head.
Dr. J. E. Johnson was appointed as Head, Distillate Fuels and Combustion Section, Code 3280.
Mr. T. D. Callinan transferred to the Electricity Division.
The Lubrication Branch was renamed Surface Chemistry Branch.

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1954

Laboratory Director	Captain W. H. Beltz	
Research Director	Dr. E. O. Hulburt	
MATERIALS AREA		
Assoc. Dir. of Res.	Dr. O. T. Marzke	Code 6000
CHEMISTRY DIVISION		
Superintendent	Dr. P. King	Code 6100
Assoc. Supt.	Mr. S. Gulbrandsen	Code 6101
Sci. Staff Asst.	Mr. V. R. Piatt	Code 6102
High Polymers	Dr. L.B.Lockhart,Jr.	Code 6110
Prot. Coatings	Dr. A.L. Alexander	Code 6120
Phys. & Inorganic	Mr. R. R. Miller	Code 6130
Prot. Chemistry	Dr. E. A. Ramskill	Code 6140
Engineering Res.	Mr. R. L. Tuve	Code 6150
Electrochemistry	Dr. J. C. White	Code 6160
Surface Chemistry	Dr. W. A. Zisman	Code 6170
Fuels	Dr. H. W. Carhart	Code 6180

NOTES:
The Laboratory code numbers were again changed; our Division codes changed from 32XX to 61XX and would remain in this numerical sequence through the author's tenure.
The FIRST Associate Directors were appointed to direct the research Areas.
Dr. P. Borgstrom retired.
Dr. P. King was appointed as Superintendent of the Chemistry Division.
Mrs. Patricia A. Miller (who was hired by the Division Superintendent as a Clerk-Typist in 1950) was promoted to the FIRST Division Administrative Assistant position.

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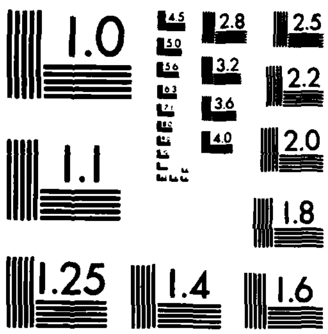

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

1952

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- -

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Laboratory Director	Captain W. H. Beltz	
Research Director	Dr. E. O. Hulburt	
MATERIALS AREA		
Assoc. Dir. of Res.	Dr. O. T. Marzke	Code 6000
CHEMISTRY DIVISION		
Superintendent	Dr. P. King	Code 6100
Assoc. Supt.	Mr. S. Gulbrandsen	Code 6101
Sci. Staff Asst.	Mr. V. R. Piatt	Code 6102
High Polymers	Dr. L.B.Lockhart,Jr.	Code 6110
Prot. Coatings	Dr. A.L. Alexander	Code 6120
Phys. & Inorganic	Mr. R. R. Miller	Code 6130
Prot. Chemistry	Dr. E. A. Ramskill	Code 6140
Engineering Res.	Mr. R. L. Tuve	Code 6150
Electrochemistry	Dr. J. C. White	Code 6160
Surface Chemistry	Dr. W. A. Zisman	Code 6170
Fuels	Dr. H. W. Carhart	Code 6180

NOTES:
The Laboratory code numbers were again changed; our Division codes changed from 32XX to 61XX and would remain in this numerical sequence through the author's tenure.
The FIRST Associate Directors were appointed to direct the research Areas.
Dr. P. Borgstrom retired.
Dr. P. King was appointed as Superintendent of the Chemistry Division.
Mrs. Patricia A. Miller (who was hired by the Division Superintendent as a Clerk-Typist in 1950) was promoted to the FIRST Division Administrative Assistant position.

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1955

Dr. L. B. Lockhart, Jr., was appointed the Head of the High Polymers Branch, Code 6110.

Mrs. P. A. Miller resigned and vacated the position of Administrative Assistant.

- -

1956

Laboratory Director	Captain Peter H. Horn
Director of Research	Dr. O. T. Marzke

MATERIALS AREA

Assoc. Dir. of Res.	Dr. P. King

CHEMISTRY DIVISION

Superintendent	Dr. W. A. Zisman
Assoc. Supt.*	Dr. A. L. Alexander
Sci.Staff Asst.	Mr. V. R. Piatt
High Polymers	Dr. L. B. Lockhart, Jr.
Protective Coatings	Dr. A. L. Alexander
Phys. & Inorganic	Mr. R. R. Miller
Protective Chemistry	Dr. E. A. Ramskill
Engineering Research	Mr. R. L. Tuve
Electrochemistry	Dr. J. C. White
Surface Chemistry	Dr. C. R. Singleterry
Fuels	Dr. H. W. Carhart

NOTES:

Dr. P. King vacated the Division Superintendent's position to assume the position as Associate Director of Research for Materials.

Dr. W. A. Zisman was appointed Superintendent of the Chemistry Division.

Dr. C. R. Singleterry was selected to Head, Surface Chemistry Branch.

Mr. S. Gulbrandsen retired.

* Dr. A. L. Alexander was selected to work in a dual capacity as Branch Head and Acting Associate Superintendent.

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1957

Code 6110 Branch name changed from High Polymers to Physical Chemistry.

Code 6120 Branch name changed from Protective Coatings to Organic and Biological Chemistry.

Code 6130 Branch name changed from Physical and Inorganic to Inorganic and Nuclear Chemistry Branch.

Mrs. Bettye C. Foster (Gibbs) was appointed Administrative Assistant

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1958

Dr. D. L. Venezky resigned his position at NRL to accept an Instructorship in Chemistry at the University of North Carolina.

Position as Director of Research, NRL, was assumed by Dr. R. M. Page.

1959

Dr. N. Lynn Jarvis selected as an National Research Council (NRC)/NRL Research Associate.

Code 6150, Engineering Research Branch, its staff and research programs were transferred to the Mechanics Division, NRL.

1960

Laboratory Director	Captain A. E. Krapf	
Director of Research	Dr. R. M. Page	
MATERIALS AREA		
Assoc. Dir. of Res.	Dr. P. King	
CHEMISTRY DIVISION		
Superintendent	Dr. W. A. Zisman	
Sci. Staff Asst.	Mr. V. R. Piatt	
Admin. Asst.	Mrs. B. C. Foster	
Consultant	Mr. V. G. FitzSimmons	Code 6104
Consultant	Mr. K. W. Bewig	Code 6105
Consultant	Mr. R. C. Taylor	Code 6106
Physical Chemistry	Dr. L.B.Lockhart, Jr.	
Organic & Biological	Dr. A. L. Alexander*	
Inorganic & Nuclear	Mr. R. R. Miller	
Protective Chemistry	Dr. E. A. Ramskill	
Electrochemistry	Dr. J. C. White	
Surface Chemistry	Dr. C. R. Singleterry	
Fuels	Dr. H. W. Carhart	

NOTES:

Mr. V. G. FitzSimmons was a consultant in the related fields of lubrication and preservation.

Mr. K. W. Bewig was a consultant in electronics for the Division.

Mr. R. C. Taylor was a consultant in rubber and plastic materials.

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1961

Dr. N. L. Jarvis was hired to work in the Surface Chemistry Branch.

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1962

Dr. D. L. Venezky reinstated at NRL in the Organic and Biological Chemistry Branch, Code 6120.

Dr. Fred E. Saalfeld hired to conduct and direct research in physical chemistry in the Physical Chemistry Branch.

Mrs. B. C. Foster promoted to FIRST Administrative Officer.

Mr. V. G. FitzSimmons, Consultant, was transferred to the Surface Chemistry Branch.

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1963

Dr. F. E. Saalfeld selected to Head the Mass Spectrometry Section, Physical Chemistry Branch.

Dr. M. C. Bloom appointed on the Division Staff as a Consultant in corrosion in ferrous systems.

1964

Dr. P. King, Code 6000, transferred from NRL to Chief Scientist, ONR, Washington, D. C.

Dr. R. L. Dolecek assumed the position of Associate Director of Research for Materials, Code 6000.

1966

Dr. R. E. Kagarise separated from NRL and was appointed Program Director for Structural Chemistry at the National Science Foundation.

1967

Following the death of Dr. R. L. Dolecek, Code 6000, Dr. J. H. Schulman became the Associate Director of Research for Materials.

Dr. R. M. Page, Code 4000, retired and Dr. A. Berman was appointed as Director of Research, NRL.

Mr. K. W. Bewig, Consultant, retired.

1968

Dr. W. A. Zisman accepted a position as Chief Scientist of the Laboratory for Chemical Physics, Code 6050, leaving the position of Superintendent of the Chemistry Division vacant.

Dr. N. L. Jarvis was reassigned from Code 6170 to the newly established Code 6050.

Dr. A. L. Alexander was Acting Superintendent from March through October, 1968.

Dr. R. E. Kagarise separated from the National Science Foundation and was appointed Superintendent of the Chemistry Division.

Dr. M. C. Bloom retired.

1969

Code 6120 Branch name changed from Organic and Biological Chemistry to Organic Chemistry.

Code 6130 Branch name changed from Inorganic and Nuclear Chemistry to Inorganic Chemistry.

Dr. C. R. Singleterry retired from the position as Head of the Surface Chemistry Branch.

Dr. N. L. Jarvis was reassigned from the Laboratory for Chemical Physics, Code 6050, to Head of the Surface Chemistry Branch, Code 6170.

Dr. D. L. Venezky reassigned from the Organic Chemistry Branch, Code 6120, to the Inorganic Chemistry Branch, Code 6130.

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APPENDIX I-2

CHRONOLOGICAL STAFF LISTING OF THE CHEMISTRY DIVISION 1970 - 1982

1970

Laboratory Director	Captain E.W. Sapp	
Director of Research	Dr. Alan Berman	
MATERIALS AREA		
Assoc. Dir. of Res.	Dr. J. H. Schulman	
CHEMISTRY DIVISION		
Superintendent	Dr. R. E. Kagarise	Code 6100
Admin. Ser. Officer	Mrs. B. C. Foster	6102
Physical Chemistry	Dr. L. B. Lockhart, Jr.	6110
Organic Chemistry	Dr. A. L. Alexander	6120
Inorganic Chemistry	Mr. R. R. Miller	6130
Electrochemistry	Dr. J. C. White	6160
Surface Chemistry	Dr. N. L. Jarvis	6170
Chemical Dynamics	Dr. H. W. Carhart	6180

NOTES:

Code 6180 Branch name changed from Fuels Branch to Chemical Dynamics Branch.

Code 6140, Protective Chemistry Branch, disestablished.

Dr. L. B. Lockhart, Jr., selected to act in a dual capacity as Branch Head, Code 6110, and as Associate Superintendent.

Mr. V. R. Piatt reassigned to Head the Environmental Pollution Control Staff

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1971

Building 207 commemorated and the physical move made from Buildings 26, 35, 54, and 53.

Mr. R. R. Miller retired as the Head, Inorganic Chemistry Branch, Code 6130, and Dr. W. B. Fox appointed as his replacement.

The Materials Area (Code 6000) renamed Materials and General Sciences Area.

Dr. J. C. White retired as the Head, Electrochemistry Branch, Code 6160, and Dr. S. Schuldiner appointed as his replacement.

Dr. R. C. Little acted as Branch Head, Surface Chemistry Branch, Code 6170, during the sabbatical of Dr. N. L. Jarvis.

1972

Dr. A. L. Alexander retired as Head, Organic Chemistry Branch, Code 6120, and Dr. J. E. Johnson appointed as his replacement.

Dr. N. L. Jarvis returned from sabbatical and resumed his position as Head, Surface Chemistry Branch, Code 6170.

- -

1973

50th ANNIVERSARY OF NRL

- -

1974

Code 6160, Electrochemistry Branch disestablished.

Dr. J. E. Johnson retired as Head, Organic Chemistry Branch, Code 6120, and Dr. L. B. Lockhart, Jr., was reassigned from Head, Physical Chemistry Branch, Code 6110, to replace Dr. Johnson.

Dr. F. E. Saalfeld replaced Dr. L. B. Lockhart, Jr., as Head, Physical Chemistry Branch, Code 6110.

Dr. J. H. Schulman, Code 6000, vacated his position to assume a position as Senior Scientist at ONR, London.

Dr. A. I. Schindler was reassigned from the Metallurgy Division to Associate Director of Research for Materials and General Sciences, Code 6000.

- -

1975

Dr. R. E. Kagarise, Superintendent, Code 6100, vacated his position and accepted a position as Director for Materials Research at the National Science Foundation.

Dr. W. A. Zisman, Head, Laboratory for Chemical Physics, Code 6050, retired and the group disestablished.

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1976

Code 6180 Branch name changed from Chemical Dynamics Branch to Combustion and Fuels Branch.

Dr. F. E. Saalfeld was selected to replace Dr. R. E. Kagarise as Superintendent, Chemistry Division.

- -

1976 TQ

Transitional Quarter for the change in timing of the fiscal years.

- -

1977

Code 6110 Branch name changed from Physical Chemistry to Chemical Diagnostics Branch.

Dr. A. B. Harvey selected to Head, Chemical Diagnostics Branch, Code 6110.

Code 6120 Branch name changed from Organic Chemistry to Polymeric Materials Branch.

- -

1978

Code 6130 Branch name changed from Inorganic Chemistry to Inorganic and Electrochemistry Branch.

The Director of Research's code was changed from Code 4000 to Code 1001.

- -

1979

Dr. F. E. Saalfeld assigned on temporary duty as Chief Scientist and Scientific Director, ONR, London.

Dr. L. B. Lockhart, Jr., retired as Head, Polymeric Materials Branch, Code 6120, and returned as a re-employed annuitant to Act as Superintendent, Chemistry Division.

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1980

Fire Protection and Damage Control Group, Code 6104, established under the direction of Dr. H. W. Carhart.

Dr. F. E. Saalfeld returned to position as Superintendent, Chemistry Division.

Dr. L. B. Lockhart, Jr., resigned from Acting Superintendent, Chemistry Division.

- -

1981

Dr. W. B. Fox reassigned from Head, Inorganic and Electrochemistry Branch, Code 6130, to Head, Polymeric Materials Branch, Code 6120.

Dr. D. L. Venezky selected to Head, Inorganic and Electrochemistry Branch, Code 6130.

Dr. N. L. Jarvis, by request, reassigned from Head, Surface Chemistry Branch, Code 6170. Dr. J. S. Murday replaced Dr. Jarvis as Branch Head.

JULY, 1982

Laboratory Director	Captain J. A. McMorris II	
Director of Research	Dr. A. I. Schindler (Acting)	

MATERIAL SCIENCE AND COMPONENT TECHNOLOGY DIRECTORATE

Assoc. Dir. of Res.	Dr. F. E. Saalfeld (Acting)	

CHEMISTRY DIVISION

Superintendent	Dr. F. E. Saalfeld	Code 6100
Assoc. Supt.	Dr. D. L. Venezky	6101
Admin. Officer	Mrs. B. C. Gibbs	6102
FP&DC*	Dr. H. W. Carhart	6104
Chemical Diagnostics	Dr. A. B. Harvey	6110
Polymeric Materials	Dr. W. B. Fox	6120
Inorg.& Electrochem.	Dr. D. L. Venezky	6130
Surface Chemistry	Dr. J. S. Murday	6170
Combustion & Fuels	Dr. H. W. Carhart	6180

* Fire Protection and Damage Control Group

NOTES:

Dr. A. Berman, Director of Research, Code 1001, resigned from the Naval Research Laboratory to accept a position at the University of Miami, Miami, Florida.

Dr. A. I. Schindler, Associate Director of Research for the Materials Science and Component Technology Directorate, Code 6000, was selected as Acting Director of Research.

Dr. F. E. Saalfeld, Superintendent, Chemistry Division, was selected as Acting Associate Director of Research for the Materials Science and Component Technology Directorate, Code 6000.

Dr. F. E. Saalfeld, Superintendent, Chemistry Division and Acting Associate Director of Research for the Materials Science and Component Technology Director, Code 6000, resigned to accept a position as Director of Research Programs (Code 400), Office of Naval Research, Washington, D. C.

Mrs. B. C. Gibbs retired from position as Administrative Officer, Chemistry Division, and was replaced by Mrs. B. L. Russell, Administrative Assistant.

APPENDIX J

CHEMISTRY DIVISION BRANCH RESEARCH
1972

APPENDIX J

CHEMISTRY DIVISION BRANCH RESEARCH - 1972

PHYSICAL CHEMISTRY BRANCH
CODE 6110
Dr. L. B. Lockhart, Jr., Head

Chemical Spectroscopy (Dr. A. B. Harvey)	Chemical, TEA, and dye lasers; transfer; gas kinetics; structures; analyses
Mass Spectrometry (Dr. F. E. Saalfeld)	Kinetics of combustion, ion- molecule, laser-induced reactions; analysis of trace contaminants, catalytic oxidation
NMR Spectroscopy (Dr. W. B. Moniz)	Analysis and structure detn; free radicals (ESR); broadline NMR; chemical shifts (theory); dye lasers
Lubricants (Mr. H. Ravner)	Thermal and oxidative stability of lubricants; additives; degradation mechanisms; synthesis
Aircraft Fuels (Dr. R. N. Hazlett)	Thermal and oxidative stability of fuels; catalysis; kinetics of oxida- reactions

ORGANIC CHEMISTRY BRANCH
CODE 6120
Dr. A. L. Alexander, Head

Organic Coatings (Mr. J. E. Cowling)	Composites, high-energy laser effects; adhesives; advanced aircraft paints; fuel tank linings
Organic Polymers (Dr. R. B. Fox)	Photophysical and photochemical processes, organic dye lasers, ablative polymers
Organic Synthesis (Dr. J. R. Griffith)	Synthesis of highly fluorinated epoxy resins, drag reducing polymeres; reaction kinetics

INORGANIC CHEMISTRY BRANCH
CODE 6130
Dr. William B. Fox, Head

Advanced Inorg. Matl. (Dr. W. Fox, Acting)	Synthesis, structure, properties of fluorocompounds; chelating additives; corrosion inhibition
Ceramics (Mr. Roy Rice)	Transducers, insulators, windows and radomes; failure mechanisms; fabrication and processing
Chem. Thermodynamics (Mr. Dale Williams)	Atmosphere analysis and control; CO and$_2$CO removal, chemical sources of O_2; EBA

ELECTROCHEMISTRY BRANCH
CODE 6160
Mr. Sigmund Schuldiner, Head

Electrode Mechanisms (Mr. S. Schuldiner Acting)	Reaction kinetics; double-layer structure; catalysis; electro-crystallization; sorption and diffusion
Batteries (Mr. A. Simon)	Energy and power densities; reliability and efficiency
High Temperature (Dr. K. Stern)	Thermal stability and vaporization of salts; transport phenomena in electrolytes and electrodes
Corrosion (Dr. R. Jones)	Growth mechanism of oxide films in high-temp. aqueous systems; surface structure; electron microscopy

SURFACE CHEMISTRY BRANCH
CODE 6170
(Dr. N. L. Jarvis, Head)
Dr. R. Little, Acting Head

Colloids (Dr. R. Little)	Drag reduction; hydraulic fluids; additives for greases and lubricants
Adhesion (Dr. W. Bascom)	Surface chemistry of glass, graphite and metal fibers; adhesive bonds in aircraft; composite materials
Corrosion Inhibition (Mr. H. Baker)	Corrosion preventive coatings; cleaning and preservation of water damaged equipment, ordnance lubricants
Adsorption (Dr. V. Deitz)	Surface chemistry of activated charcoal (adsorption) and carbon filaments (composite materials)
Surface/Solid Kinetics (Dr. J. Murday, Actg.)	Pulsed NMR; molecular diffusion in zeolites (catalysts), desalination membranes, solid electrolytes
Tribology (Dr. D. Hunston, Actg.)	Barrier coatings and specialty lubricants for precision bearings; ammo lubricants; Auger spectroscopy

CHEMICAL DYNAMICS BRANCH
CODE 6180
Dr. H. W. Carhart, Head

Distillate Fuels (Dr. J.E. Johnson)	Combustion, chemi-ions, cool flames, atomic oxygen explosiveness, flammability, atmosphere analysis, THA
Fire Suppression (Mr. H. B. Peterson)	Fire fighting agents (AFFF, dry powers, Freons); delivery systems; corrosion and storage problems
Materials (Mr. H. F. Bogardus)	Collective (STOPS) and individual personnel protection, masks, filters, charcoal fiber adsorbents, decontamination
Special Problems (Dr. J. T. Leonard)	Surface chemistry of firefighting foams, fire suppression, emergency destruction of classified materials

APPENDIX K

CHEMISTRY DIVISION PERSONNEL AWARDS AND RECOGNITION
1960 - 1981

APPENDIX K
CHEMISTRY DIVISION PERSONNEL AWARDS AND RECOGNITION
1960 - 1981

Government Awards

Navy Meritorious Civilian Service Award

1960 L. B. Lockhart, Jr.
1971 J. C. White
1978 R. C. Little
1979 M. C. Lin, J. R. Griffith
1980 E. J. Jablonski
1981 F. E. Saafeld

Navy Superior Civilian Service Award

1965 H. W. Carhart
1972 A. L. Alexander
1979 L. B. Lockhart, Jr.

Navy Distinguished Civilian Service Award

1960 P. King
1979 H. W. Carhart

DoD Distinguished Civilian Service Award

1964 W. A. Zisman

E. O. Hulbert Science Award

1976 H. W. Carhart
1981 F. W. Williams

Captain Robert Conrad Dexter Award

1968 W. A. Zisman

Secretary of Navy Award for Cost Reduction

1972 V. G. FitzSimmons

President of the United States Management Improvement Award

1972 V. G. FitzSimmons

NRL Research Publication Awards - Basic Science

1968	C. M. Shepherd, S. Schuldiner
1969	H. A. Resing
1970	S. Reines, J. R. Griffith, J. G. O'Rear
1971	M. C. Lin
1972	J. K. Hancock, W. H. Green
1973	J. R. McDonald, L. E. Brus
1974	M. C. Lin, R. G. Shortridge, W. B. Moniz, C. F. Poranski, S. A. Sojka, R. A. Smardzewski, W. B. Fox
1975	C. T. Ewing, K. H. Stern
1976	S. A. Sojka, W. B. Moniz, C. F. Poranski
1977	A. P. Baronavski, J. R. Mc Donald
1978	D. Bogan
1979	N. H. Turner, J. S. Murday, D. E. Ramaker
1980	D. E. Tevault, L. D. Talley, M. C. Lin

NRL Research Publication Awards - Applied Science

1968	V. G. FitzSimmons, C. M. Murphy, J. B. Romans. C. R. Singleterry
1969	R. N. Hazlett
1970	R. C. Little, M. Weigard
1971	A. J. Fryar, S. Kaufman
1972	R. Rice
1973	P. A. Tatem, R. G. Gann, H. W. Carhart
1974	
1975	D. E. Field, J. R. Griffith
1976	W. D. Bascom, R. L. Cottington, C. O. Timmons, F. E. Saafeld, J. R. Wyatt
1977	R. L. Jones, S. T. Gadomski, D. L. Hunston
1978	R. N. Hazlett, J. Solash, G. H. Fielding, J. Burnett
1979	D. L. Venezky
1980	R. L. Jones, K. H. Stern

Professional Society Recognition Awards

Chemical Society of Washington

Hillebrand Prize	1975	M. C. Lin
	1978	J. R. Griffith
Service Award	1973	R. B. Fox
	1975	F. E. Saafeld
	1978	D. L. Venezky
	1981	E. G. Shafrin
President	1960	A. L. Alexander
	1965	W. A. Zisman
	1968	R. B. Fox
	1972	F. E. Saafeld
	1975	R. F. Cozzens
	1976	D. L. Venezky

Electrochemical Society (National Capital Section)

Blum Award	1960	S. Schuldiner
	1968	J. Burbank
	1971	K. H. Stern
	1976	A. C. Simon
Chairman	1966	K. H. Stern

Washington Academy of Science

President	1975	K. H. Stern
Award of Joint Board of Science Education	1981	E. G. Shafrin
Award in Physical Science	1976	M. C. Lin

American Society of Lubrication Engineers

National Award	1961	W. A. Zisman

American Chemical Society

Kendall Award	1962	W. A. Zisman
Mayo D. Hersey Award	1969	W. A. Zisman
Joseph J. Matiello Award	1971	W. A. Zisman
Borden Award	1976	W. A. Zisman
Certificate of Merit from Division of Colloid and Surface Chemistry	1969	C. R. Singleterry
Chairman, Fluorine Division	1980	W. B. Fox

Alpha Chi Sigma

Professional Service Award	1976	R. B. Fox

Sigma Xi

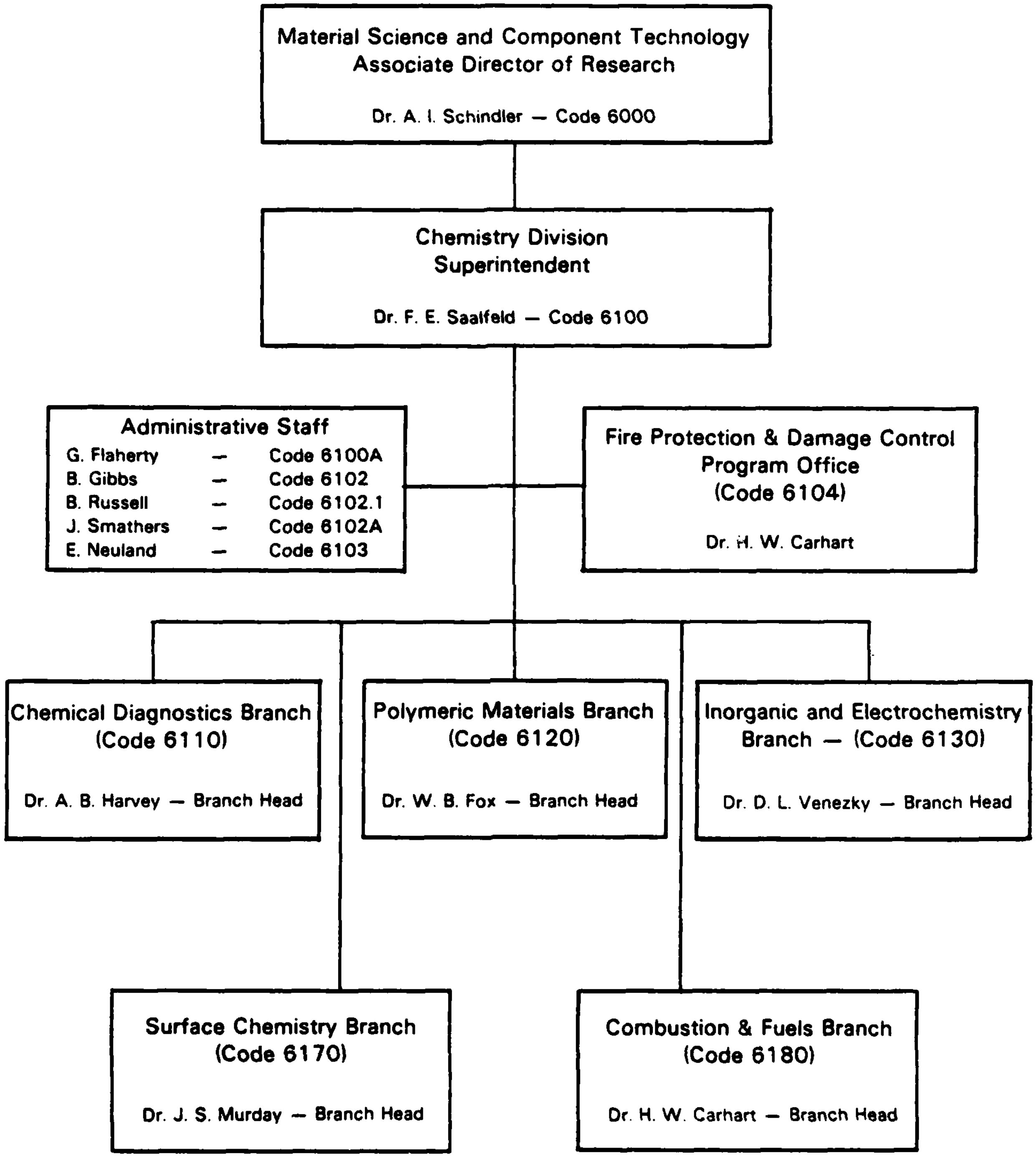
Pure Science	1962	C. R. Singleterry
	1966	S. Schuldiner
	1974	R. B. Fox
	1978	M. C. Lin
Applied Science	1976	J. R. Griffith
	1979	J. R. McDonald

APPENDIX L

CHEMISTRY DIVISION ORGANIZATIONAL STAFF AND RESEARCH PROGRAM 1982

APPENDIX L
(1)

CHEMISTRY DIVISION ORGANIZATIONAL STAFF AND RESEARCH PROGRAM
1982



APPENDIX L
(2)

FIRE PROTECTION
& DAMAGE CONTROL (FP/DC)
PROGRAM OFFICE
(6104)
DR. H. W. CARHART

- FOCUS FOR NAVY FIRE RESEARCH PROGRAM
- STAFF SUPPORT ON FP/DC
- ORGANIZE AND STAGE WORKSHOPS
- ADMINISTRATION OF CONTRACTS

APPENDIX L
(3)

CHEMICAL DIAGNOSTICS BRANCH (6110)

DR. A. B. HARVEY

OPTICAL DIAGNOSTICS

DR. J. R. McDONALD

- LASER-INDUCED FLUORESCENCE SPECTROSCOPY
- PHOTODISSOCIATION REACTIONS
- LASER CHEMISTRY
- COMBUSTION DIAGNOSTICS
- SYNTHETIC FUELS
- ION CHEMISTRY

INSTRUMENTAL DIAGNOSTICS

DR. J. R. WYATT

- CAMS (CENTRAL ATMOSPHERE MONITOR SYSTEM)
- SUBMARINE LIFE SUPPORT SYSTEMS
- ATMOSPHERIC ANALYSIS
- TRACE CONTAMINANT CONTROL
- SURFACE ANALYSIS
- LASER CHEMISTRY
- ION REACTIONS
- ION CHEMISTRY

CHEMICAL KINETICS

DR. M. C. LIN

- CHEMICAL LASERS
- KINETICS AND MECHANISMS
- LASER CHEMISTRY
- CONDENSED PHASE PHOTOCHEMISTRY
- LASER-INFLUENCED CATALYTIC REACTIONS
- ATMOSPHERE REACTIONS
- SURFACE DYNAMICS
- COMBUSTION
- CHEMISTRY

MOLECULAR DYNAMICS

DR. A. P. BARONAVSKI

- SUPERSONIC MOLECULAR BEAMS
- CARS (COHERENT ANTI-STOKES RAMAN SPECTROSCOPY)
- DIAGNOSTICS OF ENERGETIC MATERIALS
- ION CHEMISTRY
- LASER CHEMISTRY
- LASER DIAGNOSTICS

APPENDIX L
(4)

POLYMERIC MATERIALS BRANCH (6120)

DR. W. B. FOX

POLYMER DIAGNOSTICS

DR. W. B. MONIZ

- POLYMER CHARACTERIZATION
- MATERIALS ANALYSIS
- NONDESTRUCTIVE EVALUATION
- DEGRADATION AND AGING

ORGANIC SYNTHESIS AND COATINGS

DR. J. R. GRIFFITH

- FLUORINATED EXPOXIES, URETHANES, ACRYLICS
- POLYPHTHALOCYANINES
- HIGH SOLIDS COATINGS
- TANK LINING MATERIALS

ADHESIVES AND POLYMER COMPOSITES

DR. R. B. FOX

- RHEOLOGY AND MECHANICS
- STRUCTURE/PROPERTY RELATIONSHIPS
- MULTICOMPONENT POLYMERS
- ADHESIVES AND COMPOSITES
- SEMICONDUCTING POLYMERS

APPENDIX L
(5)

INORGANIC AND ELECTROCHEMISTRY BRANCH (6130)

DR. D. L. VENEZKY

ELECTROCHEMISTRY

DR. R. NOWAK

- SURFACE MODIFIED ELECTRODES
- NEW ELECTRODE MATERIALS
- ELECTROPOLYMERIZATION
- ELECTROCHEMICAL POWER STORAGE
- PHOTOELECTROCHEMISTRY
- ELECTROANALYTICAL TECHNIQUES

SOLUTION CHEMISTRY

DR. J. C. COOPER

- FAST AQUEOUS REACTIONS
- THERMAL AND PHOTOCHEMICAL REACTIONS
- CHELATING AGENTS
- SOLUTION ANALYSES (METALS AND ORGANICS)
- COMPUTER MODELING OF AQUEOUS EQUILIBRIA
- EMISSION AND ABSORPTION SPECTROSCOPIES

HIGH TEMPERATURE CHEMISTRY

DR. R. L. JONES

- HOT CORROSION
- MOLTEN SALT CHEMISTRY AND ELECTROCHEMISTRY
- ELECTRO-DEPOSITION OF REFRACTORY COATINGS
- CHEMICAL EQUILIBRIA AND THERMODYNAMIC PROPERTIES
- SCANNING ELECTRON MICROSCOPE

ADVANCED INORGANIC MATERIALS

DR. R. A. DeMARCO

- INORGANIC POLYMERS
- FLUORINE/SULFUR CHEMISTRY
- METAL ATOM CARRIERS
- HIGH ENERGY MATERIALS
- ELECTROACTIVE POLYMERS
- ESCA (ELECTRON SPECTROSCOPY FOR CHEMICAL ANALYSIS)

APPENDIX L
(6)

SURFACE CHEMISTRY BRANCH (6170)
DR. J. S. MURDAY

THEORETICAL CHEMISTRY SECTION
DR. C. T. WHITE

- ELECTRONIC STRUCTURE OF NONSIMPLE METALS
- AUGER LINESHAPE THEORY
- MODELING OF SURFACE INTERFACES
- THEORY OF SURFACE/PARTICAL INTERACTIONS
- AMORPHOUS MATERIALS

ADVANCED SURFACE SPECTROSCOPY SECTION
DR. R. R. SMARDZEWSKI

- FOURIER TRANSFORM IR SPECTROSCOPY (FTIS)
- AUGER SPECTROSCOPY
- X-RAY INDUCED PHOTOELECTRON SPECTROSCOPY
- SURFACE ENHANCED RAMAN
- SECONDARY ION MASS SPECTROSCOPY

CHEMICAL DETECTION AND COUNTERMEASURES SECTION
DR. N. L. JARVIS

- GRAPHITE FIBER INTERCALATION
- CHAFF
- CARBON/GRAPHITE COMBUSTION
- ADSORBENTS FOR PERSONNEL PROTECTION
- CHEMICAL MICRO-SENSORS

TRIBOLOGY SECTION
MR. H. RAVNER

- SURFACE MODIFICATION
- SURFACE ANALYSIS
- FRICTION AND WEAR
- LUBRICANTS
- THERMAL AND OXIDATIVE STABILITY
- SYNTHESIS

APPENDIX L
(7)

COMBUSTION AND FUELS BRANCH (6180)

DR. H. W. CARHART

FUELS

DR. R. N. HAZLETT

- SYNTHETIC FUELS
- PLANNABILITY AND IGNITION
- FUEL COMPOSITION
- FUEL PROPERTIES
- FUEL STABILITY

COMBUSTION

DR. F. W. WILLIAMS

- FLAMES
- KINETICS AND MECHANISMS
- FIRE SUPPRESSION TECHNIQUES
- COMBUSTION PROCESSES
- MODELING AND SCALING

PROTECTIVE CHEMISTRY

DR. R. C. LITTLE

- CBR DEFENSE
- AIR PURIFICATION
- SURFACE PROPERTIES
- ANTIMISTING FLUIDS
- COLLOIDAL AND POLYMER SOLUTIONS
- CHEMICAL WARFARE AGENTS
  - DETECTION
  - PROTECTIVE COLLECTION
  - DECONTAMINATION
  - PROTECTIVE CLOTHING

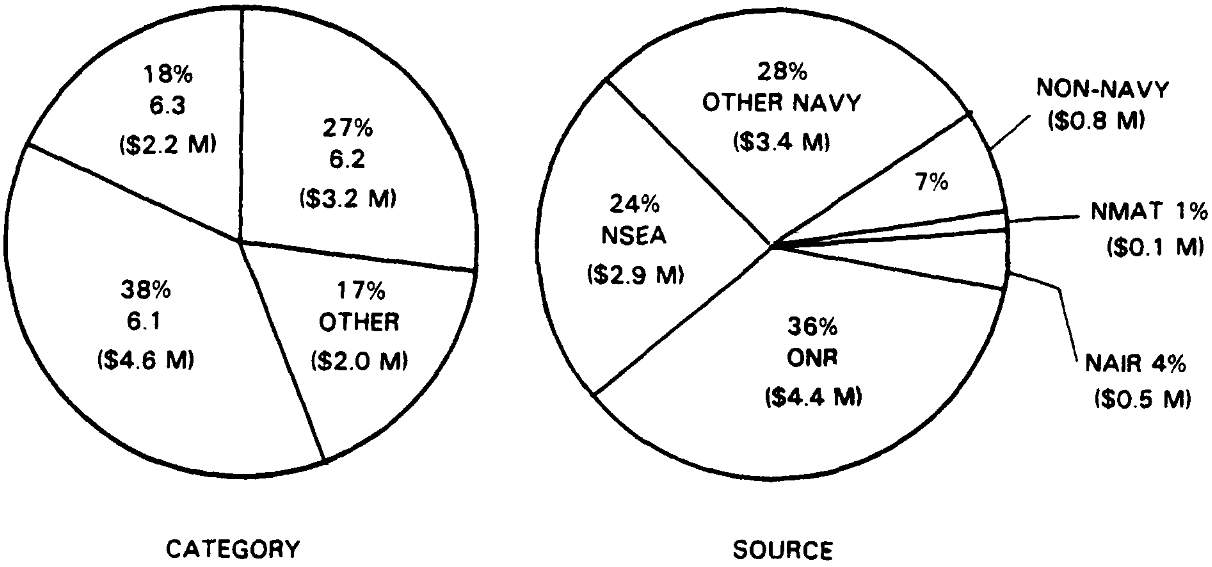
FIRE PROTECTION

DR. J. T. LEONARD

- SMOKE SUPPRESSION AND REMOVAL
- ELECTROSTATIC CHARGING OF FUELS
- DAMAGE CONTROL
- FIRE FIGHTING
- NEW AGENTS
- NEW EQUIPMENT
- AFFF (AQUEOUS FILM FORMING FOAMS)

APPENDIX M

CHEMISTRY DIVISION
FUNDING PROFILE AND RESEARCH CATEGORIES
FY 1981



FUNDING TOTAL (9/30/81) $12.1 M

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